ABSTRACTS OF NORTH AMERICAN GEOLOGY

May 1970

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

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ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports or memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

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A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242. Serial publications cited for the first time are as follows:

Alaska Univ. Mineral Industry Research Lab. Rept.—University of Alaska Mineral Industry Research Laboratory Report. College, Alaska

Am. Cryst. Assoc. Trans.—Transactions of the American Crystallographic Association. Polycrystal Book Service. Pittsburgh, Pa.

Bull. Atomic Scientists—Bulletin of the Atomic Scientists. Science and public affairs. Published by the Educational Foundation for Nuclear Science. Bulletin of the Atomic Scientists. Chicago, Ill.

Florida Bur. Geology Inf. Circ.—State of Florida Department of Natural Resources, Bureau of Geology Information Circular. Tallahassee, Fla.

Highway Research Board Spec. Rept.—Highway Research Board Special Report. National Academy of Sciences. Washington, D.C.

Joint Hydrology-Sedimentation Bull.—Joint Hydrology-Sedimentation Bulletin. Hydrology and Sedimentation Committees, Water Resources Council. U. S. Govt. Printing Office. Washington, D. C.

Rock Mechanics—Rock Mechanics. Felsmechanik. Mécanique des Roches. Journal of the International Society for Rock Mechanics (continuing the tradition of "Geologie und Bauwesen" and of "Felsmechanik und Ingenieurgeologie") Springer-Verlag. Vienna, Austria, and New York, N. Y.

Santa Barbara Mus. Nat. History Dept. Geology Bull.—Santa Barbara Museum of Natural History, Department of Geology Bulletin. Santa Barbara, Calif.

Sci. Progrès Découverte—Science Progrès Découverte. Publié avec le participation du Palais de la Découverte. Dunod, Éditeur. Paris, France.

Suo—Suo. Suoseura. Helsinki, Finland.

Wyoming Univ. Contr. Geology Spec. Paper—University of Wyoming Contributions to Geology, Special Paper. Laramie, Wyo.

The abstracts in this issue were prepared by W. Storrs Cole, Georgianna D. Conant, Howard R. Cramer, Raymond C. Douglass, John H. Feth, S. E. Frezon, Katherine A. Friberg, Andrew Griscom, Anna Hietanen-Makela, John W. Huddle, Virginia M. Jussen, B. H. Kent, Ronald W. Kistler, R. A. Loney, Elisabeth S. Loud, Mildred C. Mead, Donal R. Mullineaux, Willis H. Nelson, Virginia S. Neuschel, A. Thomas Ovenshine, Edward T. Ruppel, E. G. Sable, Vernon E. Swanson, Gregg Vane, Dorothy B. Vitaliano, Holly C. Wagner, Walter S. White, Frank C. Whitmore, Jr., Ray E. Wilcox, and R. G. Yates.

ABSTRACTS

Aadland, Rolf. *See* Picard, M. Dane. 05681

Aboudi, J. *See* Alterman, Z. S. 06282

05678 **Achauer, C. W.** Origin of Capitan Formation, Guadalupe Mountains, New Mexico and Texas: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2314-2323, illus., 1969.

The Capitan Formation originated as a linear organic bank rather than a barrier reef. Frame-building organisms, reef cores, and reef-derived detritus or talus are conspicuously absent. The long-standing practice of separating topographically a reef massive (core) unit above and a reef talus or breccia unit below is discounted. The formation can be divided into a lower dolomite unit and an upper limestone unit, both characterized by silt- and sand-size skeletal debris and by a wide assortment of invertebrate fossils. Sediment-binding algae probably were important in trapping and binding skeletal debris. — *from* Author's abstract

Adams, J. A. S. *See* Hartung, J. B. 05712

05974 **Addicott, Warren O.** Late Pliocene mollusks from San Francisco Peninsula, California, and their paleogeographic significance: California Acad. Sci. Proc., 4th ser., v. 37, no. 3, p. 57-93, illus., tables, 1969.

A late Pliocene marine fauna of 20 gastropod and 19 pelecypod taxa is described from outcrops of the Merced(?) Formation in northern Santa Clara County, on the northeast side of the San Andreas fault. The fauna lived in a protected environment similar to modern bays of central California, but a small southern element suggests somewhat warmer water. On the southwest side of the fault, across from the Merced(?) localities, the Purisima Formation bears a distinctive early Pliocene molluscan fauna. It is suggested that the Merced(?) strata may have been connected to the open ocean through an area of early Pliocene strata now located on the southwest side of the fault 20-25 miles to the northwest, a distance compatible with the estimated right-lateral slip since late Pliocene time. — VMJ

Adegoke, Oluwafeyisola S. *See* Allison, Richard C. 05803

Adler, Joel E. M. *See* Ross, Howard P. 05959

05869 **Ahrens, L. H.; vonMichaelis, H.; Erlank, A. J.; Willis, J. P.** Fractionation of some abundant lithophile element ratios in chondrites, Paper 15 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 166-173, illus., tables; discussion, p. 218-219, 1969.

The abundant lithophile elements Si, Mg, Ca, Al, and Ti have been estimated by the X-ray fluorescence method in 8 carbonaceous chondrites, 25 common chondrites, and 7 enstatite chondrites. Because of the accuracy of the data, it has been possible to determine precisely the variation of the ratios Si/Mg, Si/Ca, Si/Al, Si/Ti, and Ca/Al within each chondrite group and the fractionation, if any, of each ratio between each group. Variation of each ratio in the common chondrites is very small but is usually larger in the other types. With exception of Ca/Al which may not be fractionated at all, the degree of fractionation varies widely. Si/Mg increases by only a little more than 10 percent when passing from carbonaceous to common chondrites, whereas

that of Si/Ca and of Si/Al is extreme (about 100 percent from carbonaceous to enstatite). — *from* Authors' abstract

06352 **Ahrens, Thomas J.; Anderson, Don L.; Ringwood, A. E.** Equations of state and crystal structures of high-pressure phases of shocked silicates and oxides: Rev. Geophysics, v. 7, no. 4, p. 667-707, illus., tables, 1969.

Shock-wave data available for rocks, minerals, and oxides in the pressure range for the lower mantle are analyzed for equation-of-state parameters with emphasis on shock-induced high-pressure phases. Data for stishovite indicate no transformation to fluorite-type structures under shock. Fe_2O_3 probably transforms to perovskite or to B rare-earth structure with zero-pressure density of 5.96 g per cm^3; spinel to the $CaFe_2O_4$ structure with zero-pressure density of 4.19 g per cm^3, feldspars to hollandite structure, olivine-rich rocks with greater than 10 percent FeO to a new post-spinel polymorph, and pyroxene with more than 10 per FeO to ilmenite structure; high-pressure forms of sillimanite and andalusite have densities of 4.00 and 3.95 g per cm^3. Values of the second-order parameter ξ and of $K' = dK/dP$ are given. — *from* Authors' abstract

06269 **Aki, Keiiti; Hori, Minoru; Matumoto, Hideteru.** Microaftershocks observed at a temporary array station on the Kenai Peninsula from May 19 to June 7, 1964, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 131-156, illus., tables, 1969.

The method used to observe microaftershocks associated with the 1964 Prince William Sound, Alaska, earthquake is described and recorded aftershocks are listed. About one-tenth of the aftershocks originated in the upper mantle to a depth of about 200 km. — KAF

Akimoto, Syun-iti. *See* Morimoto, Nobuo. 06069

Algermissen, S. T. *See* Harding, Samuel T. 06243

06264 **Algermissen, S. T.** Introduction to seismological and marine geological studies of the 1964 Prince William Sound, earthquake, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 1-4, 1969.

This volume contains the principal results and conclusions of the U.S. Coast and Geodetic Survey seismological investigation of the 1964 Prince William Sound, Alaska, earthquake. Microaftershock activity, focal mechanism of the earthquake, surfact faulting, and the resulting tsunami are discussed in the volume. — KAF

Algermissen, S. T. *See* Sherburne, R. W. 06266

06268 **Algermissen, S. T.; Rinehart, W. A.; Sherburne, R. W.; Dillinger, W. H., Jr.** Preshocks and aftershocks of the Prince William Sound earthquake of March 28, 1964, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 79-130, illus., tables, 1969.

Data on 2,210 aftershocks and preshocks are presented. The aftershock area is approximately a rectangle 900 km long and 400 km wide. There was considerable temporal variation in aftershock activity with bursts of activity followed by periods of relative quiescence, although this pattern was superimposed on the general, well-known hyperbolic decrease of aftershock activity with time. Seventy-nine percent of the aftershocks for which a depth was actually computed (not restrained) by some method had depths less than 40 km. The energy released in the aftershocks sequence during the first 1,000 days was about one-tenth of the energy released in the main shock. Nearly all of the energy released in the aftershock sequence was confined to the shelf area adjacent to Kodiak Island, the Kenai Peninsula, and Prince William Sound. — Authors' abstract

Algermissen, S. T. *See* Dillinger, William H., Jr. 06271

05953 **Al-Khafaji, Saadi Abbas.** Studies of the magnetization of the Cambrian Lamotte Formation in Missouri [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1762B-1763B, 1969.

05736 **Allen, Ralph O., Jr.; Anderson, Michael R.; Marvin, Ursula B.** Simultaneous analysis for 30 elements in the Bruderheim chondrite [abs.]: Meteoritics, v. 4, no. 3, p. 149, 1969.

05803 **Allison, Richard C.; Adegoke, Oluwafeyisola S.** The *Turritella rina* group (Gastropoda) and its relationship to *Torcula* Gray: Jour. Paleontology, v. 43, no. 5, p. 1248-1266, illus., 1969.

The primary apical development, ontogeny, and other characteristics of ten turritellid taxa (including two new subspecies, *Turritella rivurbana mexicana* Allison, and *T. rivurbana chiapasensis* Allison) are discussed and are tentatively included in the *T. rina* group. Representatives of the group are known from middle to late Eocene of North and South Carolina, Florida, Georgia, Alabama, Mississippi, Louisiana, Texas, Mexico, Panama, Colombia and Peru. Members of the *Turritella rina* group are closely paralleled in adult ("cingulate") appearance by two subspecies of *Torcula*, a genus here considered a derivative of the above group: *Torcula martinensis martinensis* (Dall) from Florida (Oligocene) and *T. martinensis henkeri* Adegoke, n. subsp., from middle to late Eocene of Columbia. — *from* Authors' abstract

05907 **AlNouri, Ilham.** Time dependent strength behavior of two soil types at lowered temperatures [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1668B, 1969.

06282 **Alterman, Z. S.; Aboudi, J.** Seismic source in a layered sphere — Reflected and diffracted pulses: Jour. Geophys. Research, v. 74, no. 25, p. 5903-5922, illus., table, 1969.

An exact solution is obtained for the displacement of a surface caused by an explosive point source within a layered sphere that consists of a homogeneous solid mantle and a fluid core. For all modes of periods 4 seconds and longer, the variation of amplitude, phase changes, and range of existence of several reflected, refracted, and diffracted pulses are found and compared with observed and model experimental results. — Authors' abstract

Anders, D. E. *See* Anderson, P. C. 06176

Anders, E. *See* Heymann, D. 05849

05853 **Anders, Edward; Mellick, Paul J.** Orbital clues to the nature of meteorite parent bodies, Paper 47 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 559-572, illus., tables; discussion, p. 624-625, 1969.

A modified version of Arnold's Monte Carlo model has been used to follow the evolution of meteorite orbits on a computer. Six different starting orbits were considered and from 100-1000 runs were carried out for each starting orbit. Each orbit was tested for its ability to produce Pfibram-like final orbits, and all were found to give some number of orbits resembling Pfibram in a single characteristic. Significant differences emerged when the match was simultaneously extended to two characteristics. Asteroidal Apollo asteroids and several of the Mars asteroid families produced such orbits with a frequency to 0.5 percent, but the Moon and cometary objects did not give any Pfibram-like orbits. —*from* Authors' abstract

Anders, Edward. *See* Ganapathy, R. 06131

05779 **Anderson, Don C.** Uranium deposits of the Gas Hills, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 93-103, illus., tables, 1969.

The Gas Hills uranium district has produced about 12 percent of the United States total. Surface drilling was the most effective tool for finding and developing the

below-water-level ores. Sedimentary rocks exposed range from Cambrian to Miocene and are over 14,000 feet thick. Source beds for uranium are arkosic sandstones interstratified with lensing mudstones and shales. Two types of sandstone are present in the Wind River Formation, a yellowish-orange to yellowish-gray arkose, and a pale yellowish-gray to pale olive; both derived from Precambrian rocks. The most important type of uranium deposit in the district is solution-front deposits, formed along margins of highly altered, tabular sand beds. Ore minerals are coffinite and uraninite, and occur as a coating on, or interstitial filling between, quartz sand grains. Several quite large transitional bedded deposits have also been mined. — *from* Author's abstract

Anderson, Don L. *See* Ahrens, Thomas J. 06352

Anderson, Michael R. *See* Allen, Ralph O., Jr. 05736

Anderson, Orson L. *See* Kumazawa, Mineo. 06280

06176 **Anderson, P. C.; Gardner, P. M.; Whitehead, E. V.; Anders, D. E.; Robinson, W. E.** The isolation of steranes from Green River oil shales: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1304-1307, illus., tables, 1969.

The C_{28} sterane was identified and the presence of the C_{27} and C_{29} steranes in Green River oil shale was confirmed. This was accomplished by comparison of the spectra of the isolated components with authentic standards. — Authors' abstract

06218 **Anderson, Sidney B.** The Newcastle Formation in North Dakota, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 77-83, illus., 1969.

The Newcastle in southeastern North Dakota appears to represent deltaic deposition while that in northeastern North Dakota appears to have been largely controlled by offshore currents; the sand source was in eastern South Dakota where a large Cretaceous delta was centered. In western North Dakota, the Newcastle sands were derived from western South Dakota, Wyoming, and Montana, and deposition was controlled in part by offshore currents and to some extent by structures, as is indicated by areas of no deposition on portions of the Nesson anticline. Only a few slight oil shows have appeared to date on drill stem tests. Good reservoir potential, good source rocks above and below, varied depositional conditions, easy drilling, and shallow to moderate drilling depths make the Newcastle a good potential petroleum source. — *from* Author's conclusions

05930 **Anderson, Thomas Howard.** Geology of the San Sebastian Huehuetenango quadrangle, Guatemala, Central America [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1749B-1750B, 1969.

05884 **Anhaeusser, Carl R.; Mason, Robert; Viljoen, Morris J.; Viljoen, Richard P.** A reappraisal of some aspects of Precambrian shield geology: Geol. Soc. America Bull., v. 80, no. 11, p. 2175-2200, illus., tables, 1969.

Ancient crystalline shields throughout the world consist of cratonic nuclei, which include greenstone belts composed of slightly metamorphosed calc-alkaline volcanic rocks and superposed sedimentary rocks that were deposited in deep subsiding troughs in a thin granitic crust. The greenstone belts are similar in composition and possibly origin to circum-Pacific island arcs. After deposition the greenstone belts and enclosing granitic rocks were intruded and deformed by diapiric granitic plutons. The outer parts of the shields consist of elongated, highly metamorphosed and granitized mobile belts formed in part at least on the craton, rather than as classical geosynclines. — WHN

06001 **Anstey, Robert L.; Fowler, Michael L.** Lithostratigraphy and depositional environment of the Eden Shale (Ordovician) in the tri-State area of Indiana, Kentucky, and Ohio: Jour. Geology, v. 77, no. 6, p. 668-682, illus., table, 1969.

The Eden Shale consists mainly of blue-gray clay shale, alternating with thin beds of sparry and micritic limestone. This limestone differs significantly from the underlying Lexington Limestone, deposited in turbulent water on a carbonate shoal, and from the limestone in the overlying Dillsboro Formation, which was deposited in shallow but less agitated water. The Eden sediment was deposited in deeper, quieter water, with skeletal debris, mainly bryozoan, buried by terrigenous mud in an alternating sequence. The Lexington-Eden-Dillsboro contacts cross traditionally recognized faunal zones and time lines, and represent lithologic boundaries paleogeographically controlled by major oscillations in sea level. — VES

06273 **Archambeau, C. B.; Flinn, E. A.; Lambert, D. G.** Fine structure in the upper mantle: Jour. Geophys. Research, v. 74, no. 25, p. 5825-5865, illus., tables, 1969.

Using spectral amplitudes and traveltimes of seismic body waves, mantle velocity structures appropriate to distinct structural provinces within the western continental U.S. are determined. Structures appropriate to the Rocky Mountain and Colorado Plateau physiographic provinces show low-velocity zones capped by high-velocity lid zones. Mantle properties obtained from the Basin and Range contrast sharply with the plateau and mountain structures, with the lid zones being very thin or absent and abnormally low velocities extending from (or from very near) the base of a thin crust to 150 km. The results of the study suggest phase transitions in the mantle, including a partially melted region corresponding to the low-velocity zone, the latter being highly variable in its properties over the region studied and strongly correlated with tectonic activity. — GV

Arnold, D. *See* Camp, P. R. 06160

Arnold, J. R. *See* Marti, K. 05864

06039 **Asmussen, Loris E.; Ritchie, J. C.** Interflow or shallow phreatic flow in the coastal plain of Georgia: Jour. Hydrology, v. 9, no. 2, p. 182-193, illus., tables, 1969.

The shallow groundwater flow from a Tifton sandy loam soil was evaluated by means of groundwater wells, neutron soil moisture determinations, and water discharge from a gravel-packed tile drain. The study period was from January 1, 1968, through March 31, 1968. Shallow flow accounted for 1.80 inches of the 5.70 inches of rain received during the period. A water balance for the period was determined. — Authors' abstract

06016 **Atkinson, Larry P.; Stefansson, Unnsteinn.** Particulate aluminum and iron in sea water off the southeastern coast of the United States: Geochim. et Cosmochim. Acta, v. 33, no. 11, p. 1449-1453, illus., tables, 1969.

Concentrations of particulate iron and aluminum in river and shelf waters of the eastern United States are indirectly related to salinity, but show a loss greater than that expected from simple mixing. East coast concentrations of particulate iron are less than comparable west coast concentrations. — Authors' abstract

06033 **Auld, Bruce; Latham, Gary; Nowroozi, Ali; Seeber, Leonardo.** Seismicity off the coast of northern California determined from ocean bottom seismic measurements: Seismol. Soc. America Bull., v. 59, no. 5, p. 2001-2015, illus., tables, 1969.

About 190 local earthquakes ($\Delta < 4°$) with suboceanic epicenters were recorded over a 14-month period at a station 200 km WSW of San Francisco and 220 km south of the Mendocino fracture zone,most spatially related to the fracture system. P and S phases detected at the ocean bottom have greater amplitudes and higher frequencies than the same phases recorded at a nearby land station. This difference is ascribed to a combination of near-receiver crustal resonance effects and attenuation across the continent-ocean interface. Observations of Sn and epicentral locations support the hypothesis that the Mendocino fracture system is a transform fault. Average shear-wave velocity and thickness of the sedimentary layer are computed (from converted phases) as 0.34-0.40 kmps and 0.78-0.88 km, respectively. The false S-phase was tentatively identified on records from a coastal land station but was not observed on the ocean bottom records. — DBV

06122 **Avni, R.; Boukobza, A.** Cathode-region method for the direct spectrochemical determination of 50 trace elements in rock phosphate: Appl. Spectroscopy, v. 23, no. 5, p. 483-489, illus., tables, 1969.

A direct spectrochemical method for 50 trace elements in rock phosphate exposed only the cathode region instead of the whole dc arc plasma. In the 0.5-mm region 31 elements were analyzed, while the 0.8-mm region was used for Sc, Y, U, Th, Zr, and the rare earths. Axial gradients of the dc arc, burning in air under atmospheric pressure, were studied in order to find the suitable matrix for trace element standards. Behavior of temperature, voltage, electron density, line intensity, and particle concentration indicate calcium metaphosphate as suitable matrix for rock phosphate. When 20 percent by weight graphite was added to both, standards and samples, detection limits of traces was in the range of 0.1-10 ppm. An average of 20 percent was calculated for concentrations up to 400 ppm. — *from* Authors' abstract

05829 **Axon, H. J.** Pre-terrestrial deformation effects in iron meteorites, Paper 64 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 796-805, 1969.

Mild deformation within a meteorite parent body before kamacite begins to precipitate may produce macroscopic twins subsequently decorated by kamacite. In addition, stresses from volume changes during precipitation of kamacite may produce transformation twins on a microscopic scale that are similar to partially annealed Neumann lines and are decorated by later precipitation of rhabdite, accompanied by a later generation of fresh Neumann lines. More violent deformation occurs when parent bodies are fragmented, when collisions occur between fragments in space, or by violent impact with Earth. Pre-terrestrial damage can be distinguished if the heat alteration zone produced during atmospheric entry is shown to be later than mechanical deformation. Intense local displacements observed in normal or acicular kamacite may be confused with structures similar to displaced fields of plessite. — VSN

06295 **Aylmore, L. A. G.; Quirk, J. P.; Sills, I. D.** Effects of heating on the swelling of clay minerals, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 31-38, illus., tables, 1969.

The swelling of certain illitic clays is subject to a marked reduction (from 200 to 35 percent) water content at 10 millibars suction) after preheating, indicating the formation of very strong binding forces between individual clay particles. It seems unlikely that any deterioration of the crystal lattice has occurred. The cation exchange capacities of the clays are unaltered, and the specific surface areas are essentially the same after heating. The nature of the bonding mechanism is not yet clear, but there is evidence that small amounts of kaolinite impurities present may be involved. It seems likely that the formation of hydrogen bonds between silicate and aluminate surfaces can occur on complete removal of the adsorbed water molecules. — *from* Authors' abstract

05780 **Bailey, Robert V.** Uranium deposits in the Great Divide Basin-Crooks Gap area, Fremont and Sweetwater Counties, Wyoming, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 105-120, illus., table, 1969.

Uranium mineralization has been found in three types of deposits in this area: low-grade deposits associated with Eocene subbituminous coal and carbonaceous shale; low-grade caliche-type deposits of schroeckingerite in Eocene sediments; and higher-grade deposits, some of which are minable, in Eocene sandstone and conglomerate at Crooks Gap. Production plus reserves is estimated to be between 11 and 12 million lb of U_3O_8. Deposits are believed to be small, and schroeckingerite is water soluble. Evidence indicates that uranium was derived from the overlying Miocene(?). As a working hypothesis it is suggested that uranium in the Battle Spring Formation at Crooks Gap originated in younger volcanic-rich sediments, and after its release, migrated in slightly alkaline, weakly oxidizing ground water into the permeable Battle Spring, where Eh and pH changes resulted in concentration in zones. — *from* Author's abstract

05964 **Bailey, S. W.; Langston, R. B.** Anauxite and kaolinite structures identical [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 4, p. 241-243, 1969.

Single crystal X-ray diffraction patterns reveal that the structure of selected anauxite crystals is the same as the structure of macroscopic kaolinite crystals. Anauxite and kaolinite crystals are intergrowths on a domain scale of units in pseudotwin orientations. Individual domains in anauxite have the triclinic geometry of kaolinite, and give X-ray reflections that compare closely in intensity with those calculated from the atomic parameters of kaolinite. Large crushed crystals of anauxite give powder patterns identical with that of kaolinite. Because it has been shown recently that the chemical composition of anauxite is also identical with that of kaolinite, it is recommended that the term "anauxite" no longer be used. — Authors' abstract

Baker, D. W. *See* Griggs, D. T. 06165

06335 **Baldanza, B.; Pialli, G.** Dynamically deformed structures in some meteorites, Paper 65 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 806-825, illus., table, 1969.

A review of the main deformational structures occurring in some chondrites — such as Assisi, Bur-Gheluai, Messina, Siena and others, taken from literature — and in some hexahedrites — such as Canyon Diablo, Henbury, Otasawian (a new meteorite), and others — is presented. According to Uhlig, and Garber, Ghindin and Cirkina, the deformational structures revealed are related to coalescence of pressure with temperature, and mineralogical composition of each meteorite. It is possible, however, to establish that some differences may be found between deformations due to a relatively 'sudden' dynamic event, and others which seem more likely due to a stress action which has in some way been prolonged. — Authors' abstract

06212 **Ballard, W. W.** Red River of northeast Montana and northwest North Dakota, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 15-24, illus., 1969.

The Ordovician Red River Formation thickens toward the southeast, and varies from less than 200 to over 500 feet. The varying thickness trends reflect topographic conditions during deposition. The formation is divisible into two units, the lower one about 2/3 of the total; most petroleum production is from the upper part of the lower unit. Dolomite percentage increases toward the west, and anhydrite is restricted to the upper unit. Limestone percentage increases toward the east; micrite is common in the lower unit. The dolomite is all secondary after limestone in the lower unit; some primary dolomite may occur in the upper unit. Most of the production is from dolomite in an area where less than half the section is dolomite; the anhydrite in the upper unit may be part of the trapping mechanism. — HRC

05821 **Bambauer, H. U.; Brunner, G. O.; Laves, F.** Light scattering of heat-treated quartz in relation to hydrogen-containing defects: Am. Mineralogist, v. 54, nos. 5-6, p. 718-724, illus., 1969.

Certain quartz crystals become milky after heat treatment. The local intensity of milkiness is related to the local intensity of the 3μm absorption band and hence is related to the H content. Infrared combination bands reveal the formation of network in accordance with the reaction $2 \equiv Si\text{-}OH \rightarrow \equiv Si\text{-}O\text{-}Si \equiv + H_2O$. The scattering regions are assumed to consist mainly of H_2O-containing cavities and microdiscontinuities formed from "gel defects" during experimental annealing. Spectrochemical analyses indicate that alkali aluminum silicate precipitates are not the main cause of such milkiness. — Authors' abstract

06061 **Bandy, Orville L.; Butler, E. Ann; Wright, Ramil C.** Alaskan upper Miocene marine glacial deposits and the *Turborotalia pachyderma* datum plane: Science, v. 166, no. 3905, p. 607-609, illus., 1969.

In southeastern Alaska the first marine evidence of widespread glaciation occurs in Miocene sections near the base of the Yakataga Formation. An associated temperature decrease of about 10°C is indicated by the influx of an upper Miocene cold-water planktonic foraminifer, *Turborotalia pachyderma*, an event that occurred about 13 million years ago. — Authors' abstract

Banks, H. P. *See* Matten, L. C. 06251

Barach, G. R. *See* Graham, Earl K. 06281

05983 **Barden, L.; Khayatt, A. J.; Wightman, A.** Elastic and slip components of the deformation of sand [with French abs.]: Canadian Geotech. Jour., v. 6, no. 3, p. 227-240, illus., 1969.

The significance of a separation into elastic and slip components is considered for the case of particulate material. Tests on sand, including a variety of stress paths in a triaxial and a plane strain apparatus, indicate that for a majority of first-loading paths the total strains are closely given by the slip strains alone. The stress dilatancy theory is seen to provide a simple and accurate flow rule for predicting the slip strains. — Authors' abstract

Barghoorn, Elso S. *See* Bartlett, Alexandra S. 06070

05881 **Barker, Daniel S.** North American feldspathoidal rocks in space and time: Geol. Soc. America Bull., v. 80, no. 11, p. 2369-2372, illus., 1969.

Feldspathoidal rocks are generally considered to be postorogenic and concentrated in stable portions of continents. Of the more than 120 feldspathoidal rock occurrences in North America, only one-third are in the shield and craton; the remainder are within Phanerozoic orogenic belts. Approximately 20 percent of occurrences are pretectonic or syntectonic. In several regions (usually considered petrographic provinces) superficially identical feldspathoidal rocks were emplaced over spans of several hundred million years. Time correlation based upon petrologic similarity and geographic proximity is risky for these igneous rocks. Hypotheses stating that feldspathoidal rocks are generated during "crustal tension" and rift faulting seem inapplicable to North America. — *from* Author's abstract

Barshad, Isaac. *See* Kishk, Fawzy M. 05819

Barsky, C. K. *See* Condie, Kent C. 06045

05972 **Bartholomé, Paul.** Kamoto (Katanga) et White Pine (Michigan) — Deux gisements stratiformes de cuivre [with Flemish abs.]: Acad. Royale Sci. Outre-Mer Bull. Seances 1969, no. 2, p. 397-410, illus., 1969.

White Pine is an important copper deposit in the Upper Peninsula of Michigan. It shares certain characteristics with the deposits of central Africa: localization in a sedimentary formation, stratiform structure, and mineral zoning. The genesis of these deposits is still controversial. According to one hypothesis, mineralization resulted from a reaction between two masses of interstitial waters — one stagnant, constituting a [sulfur-rich] reducing environment; the other [carrying metals], migrating by percolation into a more permeable reservoir, constituting an oxidizing environment. — Author's French abstract, VMJ

06070 **Bartlett, Alexandra S.; Barghoorn, Elso S.; Berger, Rainer.** Fossil maize from Panama: Science, v. 165, no. 3891, p. 389-390, illus., 1969.

A palynological investigation was conducted on sediments from deep cores in the Gatun basin in Panama. Radiocarbon dates of 7300 to 4800 years were obtained. — KAF

06063 **Bartlett, Grant A.; Greggs, Robert G.** Carbonate sediments — Oriented lithified samples from the North Atlantic: Science, v. 166, no. 3906, p. 740-741, illus., 1969.

Indurated carbonate samples, obtained from the North Atlantic sea floor with a deep-sea drill coring apparatus, suggest that the phenomenon of deep-sea carbonate lithification is more complex than had been previously thought. Lithified-nonlithified couplets can now be related in age and orientation. Age determinations based on the method of C-14 dating show that adjacent nonlithified-lithified layers may differ in age by more than 30,000 years. — Authors' abstract

06128 **Barton, Paul B., Jr.** Thermochemical study of the system Fe-As-S: Geochim. et Cosmochim. Acta, v. 33, no. 7, p. 841-857, illus., tables, 1969.

The results of Toulmin and Barton (1964) for the Fe-S system have been combined with a series of new measurements on As-bearing assemblages in the 500-850°C temperature range to derive data on the free energies, enthalpies, and entropies of formation for arsenopyrite, loellingite, orpiment, realgar, $FeAs$, and Fe_2As. The enthalpies and free energies of formation of orpiment and realgar are only approximately one-half as large as indicated in recent compilations of thermochemical data. Data are also presented for the covariation of activity of $S_2(g)$ with temperature and composition of the sulfur-arsenic liquid. — Author's abstract

05737 **Bauer, Carl August.** The Pennsylvania bolide of July 2, 1968 [abs.]: Meteoritics, v. 4, no. 3, p. 150-151, 1969.

06299 **Baur, Werner H.** The crystal structure of paravauxite, $Fe^{2+}Al_2(PO_4)_2(OH)_2(OH)_8 2H_2O$: Neues Jahrb. Mineralogie Monatsh. 1969, no. 9, p. 430–433, illus., tables, 1969.

The crystal structure of paravauxite has been determined by X-ray diffraction. The mineral is isostructural with laueite. Atomic positions for the hydrogen atoms were found, thus establishing the hydrogen bonding scheme and identifying the hydroxyl groups and water molecules for compounds of this type. Positional and thermal parameters, x, y, z in fractions of the cell edge, B in A^2 and bond lengths in paravauxite are tabulated. — DBV

06349 **Baxter, Robert W.; Willhite, M. R.** The morphology and anatomy of *Alethopteris lesquereuxi* Wagner: Kansas Univ. Sci. Bull., v. 48, no. 18, p. 767-783, illus., 1969.

The morphology and anatomy of numerous specimens of *Alethopteris* leaves found in Middle Pennsylvanian Kansas coal balls are described from observations based on fractured surfaces showing entire pinnae with pinnules, and serial peel thin sections showing details of internal anatomy. The specimens are identified as being equivalent to the compression species, *A. lesquereuxi* Wagner. Observations are made on the comparative anatomy of leaves of *Alethopteris sullivanti* and *A. lesquereuxi* and the extant *Cycas revoluta*. — Authors' abstract

05738 **Beaulieu, P. L.; Moore, C. B.** The determination of silicon in iron meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 151-152, 1969.

05796 **Beerbower, James R.; Jordan, Dianne.** Application of information theory to paleontologic problems — Taxonomic diversity: Jour. Paleontology, v. 43, no. 5, p. 1184-1198, illus., tables, 1969.

Information theory is applied to measurement of taxonomic diversity and its environmental significance in samples of Recent Foraminifera from Sabine Lake and of Mississippian invertebrates from Scotland. — RCD

05844 **Begemann, F.; Vilcsek, E.** Chlorine-36 and argon-39 production rates in the metal of stone and stony-iron meteorites, Paper 29 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 355-362, illus., tables, 1969.

The production rates of Ar-39 and Cl-36 in metal phases of a number of stone meteorites (falls only) and stony-iron meteorites (falls and finds) have been measured, using a fractional dissolution technique. For the observed falls the activities, extrapolated to the time of fall, are found to be fairly constant. Results for the stone

and stony-iron meteorites are in rather good agreement but are significantly higher than those found in medium-sized iron meteorites; the same holds for the ratio Ar-39/Cl-39, at least for stony-iron meteorites. For stony-iron finds, terrestrial age is calculated from the Ar-39/Cl-36 ratio or estimated from Cl-36 activity alone. In about half of all finds analyzed even Ar-39 was still detectable, which implies that the terrestrial age is less than about 1,000 yr. — *from* Authors' abstract

05981 **Begemann, F.; Wänke, H.** ^{39}K(n,p)-produced ^{39}Ar in chondrites — New data and their interpretation in terms of size, exposure age and orbital elements, Paper 30 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 363-372, illus., tables, 1969.

Ar-39 in stone meteorites consists of a component produced by high-energy cosmic-ray particles via spallation reactions mainly on Fe and Ni, and one produced by MeV neutrons via the K-39(n,p) reaction. As total Ar-39 in different chondrites varies by a factor of about 2, and it has been shown that this is not due to variation of spallation-produced component or of potassium content, fluxes of fast neutrons in different meteoroids must have been different by at least a factor of ten. To study possible reasons for the difference, about 20 chondrites have been analyzed for Ar-39. Results indicate that for H- and L-group chondrites there is no correlation between Ar-39 and recovered mass, and Ar-39 in H-group is definitely correlated with cosmic-ray exposure age and (n,p)-produced Ar-39 with He-3/Ne-21 ratios. — *from* Authors' abstract

06330 **Begemann, F.; Rieder, R.; Vilcsek, E.; Wänke, H.** Cosmic-ray produced radionuclides in the Barwell and Saint-Séverin meteorites, Paper 23 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 267-274, illus., tables; discussion, p. 349, 1969.

The radionuclides P-32, Cl-36, Ar-37, and Ar-39 have been determined in separate mineral phases of Barwell and Saint-Séverin meteorites. Hence, not only the activities of these isotopes in the bulk sample are known, but contributions of specific neutron-induced reaction to total activity can be evaluated as well. Activities in the total sample are rather lower than normal. The Ar-37/Ar-39 ratio in metal is a direct measure of intensity ratio of cosmic-ray particles with E >200 MeV in the close vicinity of Earth, to that averaged over many revolutions of the meteoroid. For Saint-Séverin this ratio is slightly higher than one obtained from target experiments. The ratio of P-32 and Ar-39 activities is the same as that of neutron fluxes within the meteorite in the vicinity of Earth to that averaged over many revolutions of the meteoroid. — *from* Authors' abstract

Begemann, F. *See* Nyquist, L. E. 06338

05976 **Benjamin, Jack R.** Probabilistic models for seismic force design — Closure [to discussions by Hasofar and Esteva, 1969, of paper 5950, 1968]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Structural Div., no. ST10, p. 2322, 1969.

The major point in the paper (ibid., v. 94, ST5, p. 1175-1196, 1968) is that seismic engineering decisions can be studied in a rational manner recognizing the chance nature of occurrence and intensity. The probability models presented were selected on the basis of simplicity as representing the state of knowledge of occurrence and intensity for a known area of seismic activity. In view of gross assumptions involved in the use of Poisson occurrence and MM intensity, it is doubtful if any one model is much improved over another of those proposed by Hasofar (ibid., v. 95, ST1, 1968). The forecasting of events that have not been observed is a professional engineering problem not peculiar to seismic engineering. The inclusion of other than occurrence information as suggested by Esteva (ibid., v. 95, ST2, 1969) is essential in a seismic risk. — GDC

05883 **Berdan, J. M.** (and others). Siluro-Devonian boundary in North America: Geol. Soc. America Bull., v. 80, no. 11, p. 2165-2174, illus., 1969.

The writers note a convergence of opinion on a worldwide scale favoring placement of the Siluro-Devonian boundary at the base of the Gedinnian. This boundary is coincident with the base of the *Monograptus uniformis* and *Icriodus woschmidti* zones. It is recognizable in the brachiopod-coral-trilobite succession by the disappearance of pentamerids, *Atrypella*, *Gracianella*, halysitids, and *Encrinurus* and by the incoming of terebratulids, *Cyrtina*, and common *Schizophoria*. In North America, the base of the Devonian, defined as the base of the Gedinnian, is located at what is probably the most satisfactory level because it lies at or near the base of the Helderbergian, which has traditionally been regarded as the lowermost Lower Devonian stage in eastern North America. — *from* Author's abstract

06089 **Berg, R. R.** Bentonite in Montana: Montana Bur. Mines and Geology Bull. 74, 34 p., illus., tables, 1969.

Of the 172 bentonite samples collected, 53 were selected for analysis and testing. X-ray diffraction analysis of the <2μ e.s.d. fraction showed montmorillonite to be the major constituent of all samples; quartz, cristobalite, gypsum, calcite, and feldspar are present in smaller amounts in some of the samples analyzed. In the >44μ fraction of these samples, quartz, K-feldspar, plagioclase, biotite, partly altered glass, calcite, and a zeolite were identified optically. Of the 53 samples tested for possible use in rotary well-drilling mud, only two met the API minimum requirements. Three of the 26 samples tested for foundry molding sand would be satisfactory as a binder, with 11 others possibly suitable. The report also contains a summary of published information on bentonite in Montana. — *from* Author's abstract

06200 **Berg, Richard B.** Mineralogy and physical properties of some Montana bentonites, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 227-232, illus., tables, 1969.

This reconnaissance study of bentonite in Montana showed a greater percentage of the samples tested suitable for bonding use than for use in drilling mud. Although only three samples from the Fort Union Formation were tested, one of these was judged satisfactory for use in foundry molding sand. Perhaps further examination of bentonite in the Fort Union Formation might indicate other beds of bentonite having desirable properties. — Author's conclusions

Berg, Robert R. *See* Davies, David K. 06203

Berger, Rainer. *See* Bartlett, Alexandra S. 06070

06312 **Berggren, W. A.** Cenozoic chronostratigraphy, planktonic foraminiferal zonation and the radiometric time scale: Nature, v. 224, no. 5224, p. 1072-1075, illus., tables, 1969.

Relationships proposed earlier (in press) are revised as a result of new radiometric dates from Pacific Coast Miocene stages. The Zemorrian-Saucesian boundary is set at 22.5 m.y., Saucesian-Relizian at 15.3 m.y., Relizian-Luisian at 13.7-14.5 m.y., and Luisian-Mohnian at 0<13 m.y. A table relates Cenozoic biostratigraphic levels, chronostratigraphic datum planes and geologic boundaries to an absolute time scale; another correlates Late Eocene-Pleistocene chronostratigraphic units with the radiometric scale. Significantly, the vertebrate paleontologists' correlation of standard nonmarine sections of California with nonmarine equivalents in Europe does not correspond to limits of the European stages. It is now possible to place within a time framework biostratigraphic datums, first appearances and extinctions of fossil species, changes in coiling direction, and rates of organic evolution in various fossil groups. — DBV

Berkman, Saul C. *See* Spaeth, Mark G. 06242

Berman, Sol. *See* Helz, A. W. 06123

Bernard, Claude. *See* Laverdière, Camille. 06149

05866 **Bernas, R.; Gradsztajn, E.; Yaniv, A.** Isotopic composition of lithium in some meteorites and the role of neutrons in the nucleosynthesis of the light elements in the solar system, *in* Meteorite research (P.M.Millman, editor)—Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 123-131, illus., tables; discussion, p. 132-145, 1969.

Possible variations in the Li isotopic composition of several meteorites (Richardton, Mezö-Madaras) have been studied by measurements performed with an ion-sputtering mass spectrometer which enables a point-by-point analysis of the meteoritic material. Variations as high as 20 percent were observed in meteorites, while in terrestrial stones the natural ratio was constant. Results are consistent with those recently observed on Holbrook meteorite. Variations were examined very carefully and no instrumental effect found which could explain these anomalies. If a neutron irradiation is retained as a possible explanation, the variations observed are within limits compatible with effects expected from a small neutron irradiation of a Li-7/Li-6 mixture with an initial ratio different from the natural one. — VSN

Berry, F. E. *See* Harrison, W. W. 05970

Best, Myron G. *See* Moore, J. M., Jr. 05769

Bhandari, N. G. *See* Marti, K. 05864

Biemann, K. *See* Murphy, Robert C. 06068

06204 **Biggs, C. A.; McGregor, A. A.** Physical relationships of the Muddy Sandstone in the northeast Powder River basin, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 107-119, illus., 1969.

The Muddy oil and gas production is primarily stratigraphically controlled. There are at least two members of the Muddy, a lower, nonmarine unit deposited in topographic lows, and an upper, more extensive marine unit. Isopach studies of the underlying Skull Creek Shale indicate it was extensively eroded prior to lower Muddy deposition. Major Muddy production occurs in areas of maximum or minimum thickness of the Skull Creek. The upper Muddy has the best reservoir characteristics although the lower unit is thicker. Where productive, both members of the Muddy contain one or more interfingering or overlapping discontinuous sand lenses. Detailed stratigraphic studies are the most successful exploration tool in looking for Muddy oil fields. — *from* Authors' conclusions

06334 **Binns, R. A.** A chondritic inclusion of unique type in the Cumberland Falls meteorite, Paper 57 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 696-704, illus., tables; discussion, p. 716-717, 1969.

New chemical, mineralogic, and electron-probe data reveal one of the black chondrite inclusions in Cumberland Falls to be a variety bridging the apparent gap between enstatite and olivine-bronzite chondrites. The white host material is more thoroughly brecciated, and its pyroxene more extensively disordered, than most other enstatite achondrites. Petrographic relations indicate that the chondritic and achondritic portions of the stone accumulated together after having been shocked, but do not reveal any fundamental genetic relation between the two components. Evidence suggests that they were not closely associated on the same parent body prior to fragmentation. The unique composition of inclusions implies that chondritic stones do not display the complete range of possible oxidation states. — *from* Author's abstract

05960 **Bissada, K. K.; Johns, W. D.** Montmorillonite-organic complexes — Gas chromatographic determination of energies of interaction [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 4, p. 197-204, illus., tables, 1969.

Gas-solid chromatographic measurements of interaction energies were made for the systems ethanol and acetone with K-, Na-, Ba-, and Ca-montmorillonites. The results reveal an increased interaction energy in the order: K-mont < Na-mont < Ba-mont < Ca-mont. Interaction energies ranged from about 14 kcal/mole for K-montmorillonite to about 30 kcal/mole for Ca-montmorillonite. A very good agreement was observed between experimental heats of adsorption values and theoretical values for the electrostatic attractive energy between the respective cations and polar molecules. These results confirm our earlier suggestions that complex formation takes place through cation-dipole interactions and that the polar molecules solvate the exchange cations in a manner similar to the hydrations of cations in aqueous solutions. — Authors' abstract

05931 **Black, Bruce Allen.** Origin of isolated sandstone masses in shales of Late Paleozoic flysch, Ouachita Mountains, southeastern Oklahoma [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1750B, 1969.

06095 **Black, Robert F.** Climatically significant fossil periglacial phenomena in northcentral United States: Biul. Peryglacjalny, no. 20, p. 225-238, illus., 1969.

Periglacial phenomena and processes are discussed under nine general categories and their use in interpreting past periglacial climates of north-central United States is evaluated. Fossil ice-wedge casts, numerous in this region, are diagnostic not only of permafrost, but also of range of temperatures required for formation of the wedges, even though dating of wedge formation and destruction has been unsatisfactory. Other forms of patterned ground, solifluction, frost riving, asymmetrical valleys, eolian phenomena, and congeliturbation structures, are present in the region, but provide at best only qualitative information on the past climate. Evidence of thermokarst, ice mounds (pingos), and icings is unconfirmed. The periglacial climate of Wisconsin, between about 30,000 and 13,000 years ago, is hypothetically reconstructed. — VMJ

05770 **Blackburn, W. H.; Dennen, W. H.** A grinding apparatus for the accurate removal of thin layers from rock slabs: Am. Mineralogist, v. 54, nos. 5-6, p. 980-981, illus., 1969.

A vacuum holder fitted with carbide plates that limit grinding depth is adjustable to 0.001 inch. — Authors' abstract

06288 **Blaser, Harold D.; Scherer, Oscar J.** Expansion of soils containing sodium sulfate caused by drop in ambient temperatures, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 150-160, illus., table, 1969.

The salt heave phenomena as it appears in southern Nevada is due to temperature variations. Soils that contain over 0.2 percent Na_2SO_4 in solution and 15 percent or more of minus 0.005-mm fractions should always be investigated for salt heave if ambient daily temperatures vary from 35 to 100°F and if ample soil moisture is available. $CaCl_2$ or phosphoric acid treatment of soils that contain soluble sulfates do not completely eliminate the possibility that sulfates in underlying soil may rise to the surface. Blending sulfate-laden soils with open-grained material would be a solution. Expansion due to sulfate salts can occur separately or concurrently with other expansive characteristics of clay soils. Adequate surcharge loading can reduce the expansion. — *from* Authors' conclusions

05823 **Bleibtreu, Hermann K.** Evolutionary anthropology — A reader in human biology: Boston, Mass., Allyn and Bacon, 456 p., illus., tables, 1969.

This reader consists of theoretical statements and research reports written by scholars from 1954-67 for the nonspecialist and dealing with human evolution and human variation. It introduces the beginning college student to the study of physical anthropology without protecting him from some complexities and problems that are intellectually stimulating, and it should encourage the more advanced student to become familiar with the synthetic theory of evolution as the basic framework for

study and research in human biology and paleontology. Papers are grouped into the following categories: study of evolution, problems in primate taxonomy, hominid paleontology, races past and present, intrapopulation variation, genes and ancestry, selection, adaptability, genetic drift, culture and microevolution. Papers pertinent to geology have been cited in earlier bibliographies of North American geology. — MCM

05807 **Bloss, F. Donald.** Indexing powder patterns for cubic materials: Am. Mineralogist, v. 54, nos. 5-6, p. 924-930, illus., tables, 1969.

Powder diffraction patterns for isometric crystals become self-indexing if one calculates the quotients d_1^2/d_1^2, d_1^2/d_2^2, . . ., d_1^2/d_n^2 where d_1 is the largest interplanar spacing observed and d_2, . . . , d_n are successively smaller ones. The resultant set of squared quotients will then identify with one of the columns in Table 1 whereupon all lines become indexed. An advantage of this method over the commonly used graphic method is that reflections for which 2θ and $(h^2+k^2+l^2)$ are large are indexed as easily as those for which 2θ and $(h^2+k^2+l^2)$ are small. — Author's abstract

06337 **Bochsler, P.; Eberhardt, P.; Geiss, J.; Grögler, N.** Rare-gas measurements in separate mineral phases of the Otis and Elenovka chondrites, Paper 68 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 857-874, tables; discussion, p. 931-933, 1969.

Olivine, pyroxene, and feldspar mineral concentrates were prepared from the Otis and Elenovka chondrites, and very high-purity troilite and metallic FeNi fractions were separated from Elenovka. Concentrations and isotopic compositions of He, Ne, and Ar were determined in the separated phases. K-40/Ar-40 ages of the bulk meteorite, the three silicate fractions, and troilite concentration from Elenovka are between 4.31 and 4.67 b.y.; of Otis feldspar concentrate, 4.23 b.y. yt; and pyroxene, olivine, and bulk meteorite, between 2.24 and 2.39 b.y., indicating diffusion loss in fine grained material. Production rates of $Ar\text{-}38_{spall}$ from Fe and Ca, and of $Ne\text{-}21_{spall}$ from S, Si, and Mg are calculated from measured noble-gas results and measured chemical composition of mineral fractions. Results are discussed and compared with published values. — *from* Authors' abstract

Bohor, Bruce F. *See* Thomas, Josephus, Jr. 05961

06035 **Bollinger, G. A.** Seismicity of the central Appalachian states of Virginia, West Virginia, and Maryland — 1758 through 1968: Seismol. Soc. America Bull., v. 59, no. 5, p. 2103-2111, illus., table, 1969.

The central Appalachian region, characterized by a moderate amount of low-level earthquake activity, has received very little attention from earthquake seismologists because of its low energy release. This paper synthesizes several published lists of earthquakes which cover the period 1758-1963 and updates them through 1968. For the total of 152 earthquakes, the table gives year, date, locality, time, latitude and longitude, felt area (where possible), intensity of magnitude (where possible), and reference. Figures show the areal distribution of these shocks, number per decade, and annual seismic activity. — DBV

06219 **Bolyard, Dudley W.** Muddy Sand oil potential in South Dakota, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 85-94, illus., 1969.

When the Muddy sands were deposited, part of western South Dakota was in the same depositional province as the currently producing oil fields of southeast Montana, northeast Wyoming, southwest Nebraska, and northeast Colorado. Thick reservoirs, classical examples of permeability barriers, and shows of oil and gas are present in western South Dakota. Fields ranging up to 100,000,000 bbl of oil are a reasonable expectation. — *from* Author's conclusions

06301 **Botz, M. K.** Hydrogeology of the Upper Silver Bow Creek drainage area, Montana: Montana Bur. Mines and Geology Bull. 75, 32 p., illus., tables, geol. map, 1969.

The Upper Silver Bow Creek drainage basin, in southwestern Montana, is entirely within the Boulder batholith. Granitic rocks and alluvium derived from their weathering are the most abundant geological materials. A 23-sq mi alluvial-filled valley, south of Butte, is the principal aquifer. The mountains surrounding the valley are predominantly fractured granitic rocks that in many places contain ground water. Alluvium in most of the area will yield sufficient water for domestic and stock use, and in selected areas several hundred gpm. Fractured rock in many places yields sufficient water for domestic and stock use. Streams entering the valley seem to be the principal source of ground-water recharge. About 440,000 acre-feet of ground water is in storage within the upper 200 feet of saturated alluvium. Scattered data indicate little annual fluctuation of the water table. Water quality is generally good. — *from* Author's abstract

Boukobza, A. *See* Avni, R. 06122

06115 **Bowman, James F., 2d; Lodding, William.** The Pensauken Formation—A Pleistocene fluvial deposit in New Jersey, *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions—Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 3-6, illus., 1969.

A detailed study of the texture, mineralogy, and structure of the Pensauken Formation strongly indicates a fluvial environment of deposition with paleoslope toward the southwest. A bauxitic laterite-type of weathering is revealed by X-ray diffraction analysis. This weathering, in conjunction with other evidence, suggests that the Pensauken was deposited during a relatively warm, interglacial period. — Authors' abstract

06313 **Boyle, R. W.; Dass, A. S.; Church, D.; Mihailov, G.; Durham, C.; Lynch, J.; Dyck, W.** Research in geochemical prospecting methods for native silver deposits, Cobalt area, Ontario, 1966: Canada Geol. Survey Paper 67-35, 91 p., illus., tables, geol. map, 1969.

Analyses included wallrocks near native silver veins; soils, tills, and glacial clay across veins; and stream, spring, and underground waters and precipitates. Gamma-ray scintillometer surveys were made across veins underground and on the surface. Some 2,461 samples were analyzed for 14 metals; 360 samples of waters for total heavy metals; and Eh, pH, and temperature determined. Conclusions are: trace-element analyses of clay and derived soils are not effective for silver prospecting, analyses of till and derived soils should be effective, drill core samples and rock chips indicate presence of veins, water analyses are difficult to interpret but may be useful to locate the area of silver deposits, natural iron and manganese precipitates are greatly enriched in eight metals near silver deposits, and care must be taken with geochemical prospecting because of contamination present. — *from* Authors' abstract

05792 **Bradshaw, Lael Ely.** Conodonts from the Fort Peña Formation (Middle Ordovician), Marathon basin, Texas: Jour. Paleontology, v. 43, no. 5, p. 1137-1168, illus., table, 1969.

Identified conodonts from the early Middle Ordovician Fort Pena Formation of the Marathon basin, West Texas, belong to 58 species of 30 genera. Two new genera, *Oistodella* and *Tripodus*, and 8 new species are proposed. The fauna contains elements found in the Pratt Ferry Formation of Alabama, the Joins Formation of Oklahoma, the Martinsburg Formation of New Jersey and the Pogonip Group of Nevada. It also has species in common with the *Crassicauda* Limestone of Sweden, the *Ampyx* Limestone of Norway, and with Ordovician shale and chert units in Scotland. — Author's abstract

Bredehoeft, John D. *See* Pinder, George F. 06318

Brindley, G. W. *See* Thompson, T. D. 05810

06083 **Broecker, W. S.; Ku, T. L.** Caribbean cores P6304-8 and P6304-9 — New analysis of absolute chronology [Discussion of paper by E. Rona and C. Emiliani, 1969]: Science, v. 166, no. 3903, p. 404-406, illus., tables, 1969.

Broecker and Ku question the reliability of the data from which the new dates reported by Rona and Emiliani were calculated. A tabulated comparison of the two sets of dates show differences that greatly exceed experimental uncertainties. A test of validity of the analytic scheme is discussed and it is shown how magnetic reversal measurements and other geologic arguments support the Broecker-Ku results. It is felt that the results of Rona and Emiliani cannot be accepted. — VSN

Broecker, Wallace S. *See* Li, Yuan-Hui. 05910

Brookins, Douglas G. *See* Chaudhuri, Sambhudas. 05686

05932 **Brown, Dwight Delon.** Palynology of the Hannibal Formation (Lower Mississippian) of northeast Missouri and western Illinois [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1750B-1751B, 1969.

06038 **Brown, M. C.; Wigley, T. L.; Ford, D. C.** Water budget studies in karst aquifers: Jour. Hydrology, v. 9, no. 1, p. 113-116, illus., 1969.

The existence of direct underground flow rates has been established by limestone hydrology studies, and a method which determines the water budget of a karst system was devised. The method combines stream gauging data with simultaneous dye connection and gauging tests. The use of fluorescent dyes and other tracers is described. The method was tested on a large karst system in southern British Columbia, comprised of a glacier-fed stream which sinks in a deep pool and passes beneath a mountain to a well-defined spring. All input proved to go to the single output. — ESL

Brown, R. D., Jr. *See* Hamilton, R. M. 06189

05903 **Brown, Seward Ralph.** Diagenesis of chlorophylls in lacustrine sediments [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1550B-1551B, 1969.

05966 **Bruch, John C., Jr.** Capillarity and seepage from an array of channels: Am. Soc. Civil Engineers Proc., v. 95, paper 6972, Jour. Eng. Mechanics Div., no. EM6, p. 1403-1416, illus., table, 1969.

The problem of seepage losses from a system of parallel triangular channels having a capillary fringe is solved exactly by use of conformal mapping techniques. The theory predicts the discharge per channel and the height of capillary rise as functions of the physical dimensions of the channel-drain system and the maximum depth of free surface between channels. In general, the system is underlain by a drainage layer at a finite depth. The case of an infinitely deep aquifer is solved separately. Numerical examples for channels having unit side slopes are given with the results presented in the form of a table. — ASCE abstract

06274 **Bruner, E. C., Jr.; Wilson, T. E.** Deuterium in the Earth's exosphere: Jour. Geophys. Research, v. 74, no. 26, p. 6491-6493, illus., 1969.

Signal averaging techniques, applied to high resolution spectra of the solar Lyman-alpha line, have revealed a weak absorption feature in the short wavelength wing of the line. The position and shape of this feature suggest that it be identified as the Lyman-alpha transition in deuterium. Assuming this identification and a Doppler profile, a three-parameter fit to the data yields a central wavelength of 1215.346 A, a temperature of 1150°K, and an optical depth of 0.05. The temperature and optical depth thus found imply an enrichment factor of about 180 for the H/D ratio at 160 km, when compared with the natural abundance at the Earth's surface. — Authors' abstract

Brunner, G. O. *See* Bambauer, H. U. 05821

05739 **Buchwald, V. F.** Damaged iron meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 154-155, 1969.

05874 **Buehler, Edward J.** Cylindrical borings in Devonian shells: Jour. Paleontology, v. 43, no. 5, p. 1291, illus., 1969.

Cylindrical borings [possibly by gastropods] perpendicular to the shell surface of Hamilton [Group, western New York] brachiopods (chiefly *Athyris spiriferoides*) are described. They are common and are characterized by sharp outline and smooth sides. — Author's abstract

06034 **Bufe, C. G.; Willis, D. E.** High frequency teleseismic energy from Aleutian sources: Seismol. Soc. America Bull., v. 59, no. 5, p. 2061-2070, illus., tables, 1969.

The Long Shot event, detonated at Amchitka in the Aleutian Islands, was recorded at three sites in Michigan at distances of 57° to 63°. Analysis of data recorded on magnetic tape shows significant high frequency (4-5 Hz) energy in the first compressional wave arrivals at all three stations, although the most prominent spectral peaks are in the range 1.0 to 1.6 Hz. Initial P phases of aftershocks of the Good Friday earthquake of 1964 recorded at the Ann Arbor station do not contain appreciable energy above about 2 Hz. However the P-wave spectrum of an earthquake of comparable magnitude whose epicenter is near Long Shot is very similar to that of Long Shot, and indicates a favorable signal-to-noise ratio to 5 Hz. Long Shot spectra and apparent angle of incidence at Michigan stations appear to be influenced by the presence of pP and by crustal layering. — *from* Authors' abstract

Bukry, David. *See* Gartner, Stefan, Jr. 05799

06194 **Bukry, David; Kennedy, Michael P.** Cretaceous and Eocene coccoliths at San Diego, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 100, p. 33-43, illus., tables, 1969.

Coccoliths, the skeletal plates of certain fossil marine algae, were used during geologic mapping of San Diego, California, as aids in distinguishing between lithologically similar Upper Cretaceous and Eocene rock units and in contributing to the intercontinental correlation of the units. — Authors' abstract

Bunch, T. *See* Greeley, R. 05710

05740 **Bunch, T. E.; Keil, Klaus.** Chemistry of chromite in non-chondritic meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 155-157, 1969.

05741 **Bunch, T. E.; Keil, Klaus.** Mineral compositions and petrology of silicate inclusions in iron meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 157-158, 1969.

Burchell, P. W. *See* Keller, E. R. 06225

Burford, R. O. *See* Hamilton, R. M. 06189

06228 **Burger, John A.** Stratigraphic problems in the Cretaceous system along the north flank of the Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 193-194, 1969.

Cretaceous rocks are exposed along the western edge and the northeastern flank of the Uinta Range, but are covered with an overthrust on the north flank. Ten different stratigraphic questions are posed to emphasize the differences in the sections where exposed. A recently-drilled area needs careful evaluation of the Cretaceous section. — HRC

Burnett, D. S. *See* Wasserburg, G. J. 05850

Burnham, C. W. *See* Hsu, L. C. 06341

05973 **Burnham, C. Wayne; Holloway, John R.; Davis, Nicholas F.** Thermodynamic properties of water to 1,000°C and 10,000 bars: Geol. Soc. America Spec. Paper 132, 96 p., tables, 1969.

Tabulated thermodynamic functions for water cover temperature range 20-1,000°C in 20° intervals, and pressure range 100-10,000 bars in 100-bar intervals. Separate tables are presented for Gibbs free energy at 0.01 and 1.0 bars and for coefficients in three empirical equations of state upon which tabulated values >1,000 bars are based. Tabulations up to 800°C and 1,000 bars were obtained from *Steam Tables 1964* (Bain, 1964); those above 1,000 bars are based on specific volume measurements of Burnham, Holloway and Davis (1969). Uncertainty in tabulated values of specific volume and enthalpy below 1,000 bars is ± 0.1 percent; above 1,000 bars ± 0.3 percent in specific volume, Gibbs free energy and entropy, ± 0.6 percent in enthalpy and ± 1.3 percent in fugacity and fugacity coefficient. — *from* Authors' abstract

Burrous, Chester M. *See* Sherif, Mehmet A. 06293

05742 **Buseck, Peter R.** Surface metamorphism produced during atmospheric passage of pallasites [abs.]: Meteoritics, v. 4, no. 3, p. 158-160, 1969.

06320 **Buseck, Peter R.; Goldstein, Joseph I.** Olivine composition and cooling rates of pallasitic meteorites: Geol. Soc. America Bull., v. 80, no. 11, p. 2141-2158, illus., tables, 1969.

Electron microprobe measurements of olivine and metal in about 85 percent of the known pallasites show that, in most, olivines are unzoned and coexisting crystals have identical compositions, indicating high internal equilibrium. Relative to terrestrial olivines, pallasitic olivines are depleted in Ni; low Ni contents are consistent with metal-olivine equilibrium at 1000°C or less. Pallasites cooled more slowly than most iron meteorites and form a homogeneous cooling rate group. Application of a modified Prior's rule to the pallasites suggests that olivine and metal equilibrated in the presence of other silicates. Observed distribution of the olivine is compatible with that predicted from a chondritic parent melt. The pallasites were probably derived from deep within their parent body. Most iron meteorites either formed from different parent bodies or came from isolated metal pools within the silicate mantle. — *from* Authors' abstract

05777 **Butler, Arthur P., Jr.** Ground water as related to the origin and search for uranium deposits in sandstone, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 81-86, illus., table, 1969.

Slightly alkaline bicarbonate sulfate ground water, similar to modern ground water, is thought to have been the agent that formed uranium deposits in fluviatile sandstone in Wyoming. Such water has the general characteristics of the aqueous solution which investigations indicate could transport uranium at low temperatures and from which it could be precipitated. Lack of evidence for conduits in underlying rocks and absence of igneous rocks near deposits suggest that they were not formed by juvenile thermal water. The large volume of mildly oxidized rocks marginal to the deposits suggests that oxygen-poor connate water was not the agent. Modern ground water moves downward in the same direction as associated surface drainage; the ancient water which formed the deposits undoubtedly moved in a similar way. Besides being the agent for emplacement of uranium, ground water may be a guide to general areas in which deposits occur. — *from* Author's abstract

Butler, E. Ann. *See* Bandy, Orville L. 06061

Cailleux, André. *See* Hamelin, Louis-Edmond. 06147

06357 **Cailleux, André.** Introduction au Quaternaire du Québec, *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 229–232, illus., 1969.

A review of the history of the Tertiary-Quaternary terminology is followed by a review of the various aspects of study of the Quaternary: archaeology begun by the

Danes, pedology from Russia, palynology begun by the Swedes, and absolute dating begun in the United States and Russia as well as lithology, periglaciology, and even tectonism, which have developed as a result of interest in the Quaternary. This symposium was held at Chicoutimi in September 1968, and various aspects of the Quaternary of Quebec are discussed. Each of nine articles is cited separately. — HRC

05825 **Calvin, Melvin.** Chemical evolution — Molecular evolution toward the origin of living systems on the Earth and elsewhere: New York and Oxford, England, Oxford Univ. Press, 278 p., illus., tables, 1969.

Chemical evolution, assuming that life appeared on Earth as a result of normal operation of physical and chemical laws, implies a period of transition between a nonliving molecular population and one of molecular aggregates that would be called living. Approaches used here are those of molecular paleontology — the look backward in the historical record, and construction of hypothetical chemical systems that could give rise to living organisms. Chapter headings for the first approach are fossil record, nature of hydrocarbons in micro-organisms, molecular paleontology; for the second, chemical evolution, primitive chemistry, selection and growth of molecules, growth of molecules and information coupling, three-dimensional structure and self-assembly, generation of membrane structure. A closing chapter, search for significance, an appendix on possibilities of interstellar communication, bibliography, and author and subject indexes are included. — MCM

Calvin, Melvin. *See* VanHoeven, William. 06129

06144 **Cameron, Roy E.** Cold desert characteristics and problems relevant to other arid lands, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 167-205, illus., tables, 1969.

Cold deserts, the last deserts to be investigated on this planet, closely resemble polar and high-mountain deserts in many respects and share many problems in common with other arid regions. Antarctica contains typical cold deserts in its dry valley areas; various aspects of the geomorphology, hydrology, climate, soils, vegetation, and microbiology show similarities and differences to those of high Arctic and other desert areas. Colonization and exploitation of cold deserts are difficult because of geographical position, remoteness, harsh environment, and the large logistic burden. Problems and adaptation of man in cold deserts are similar to those of an outpost society. — *from* Author's abstract

06160 **Camp, P. R.; Kiszenick, W.; Arnold, D.** Electrical conduction in ice, *in* Physics of ice — Internat. Symposium, Munich, Germany, 1968, Proc.: New York, Plenum Press, p. 450-470, illus., table, 1969.

An extensive series of measurements have been made of the d-c conductance and the audio-frequency reactance of ice under laboratory conditions in which the ice is of the highest purity possible. Results indicate that the d-c conductivity of freshly made ice is apparently nearly independent of temperature down to at least -65°C. Samples of slightly lower purity exhibited a similar plateau but at a higher value of conductivity and over a smaller temperature range below which conductivity dropped off with decreasing temperature. The samples exhibited symmetry between d-c conductivity and radio frequency conductivity which suggests that two processes contribute in series to the d-c conductivity and in parallel to the a-c conductivity. — VSN

06284 **Campbell, Malcolm J.; Ulrichs, Juris.** Electrical properties of rocks and their significance for lunar radar observations: Jour. Geophys. Research, v. 74, no. 25, p. 5867-5881, illus., tables, 1969.

Terrestrial solid rocks and powders of various types have been studied at frequencies of 450 MHz and 35 GHz in an effort to determine the range of variation of high-frequency electrical properties. As solid materials show wide variations in permittivity and absorption length, it is unlikely that measurements limited to these radar

frequencies will be useful for identification. With powdered rocks, on the other hand, the variation from rock type to rock type is much smaller but depends on the powder density in a predictable way. Hence, radar information can be employed to make precise estimates of density and of density profiles even in the absence of information about composition. The long absorption lengths in powdered rocks indicate that radar reflections may occur at considerable depths in a regolith of the type found on the Moon. — GV

05757 **Canada Geological Survey.** Aeromagnetic series, La Poile River, Newfoundland: Canada Geol. Survey Geophysics Paper 4491, scale 1:63,360, 1969.

05758 **Canada Geological Survey.** Aeromagnetic series, Peter Snout, Newfoundland: Canada Geol. Survey Geophysics Paper 4492, scale 1:63,360, 1969.

05759 **Canada Geological Survey.** Aeromagnetic series, White Bear River, Newfoundland: Canada Geol. Survey Geophysics Paper 4493, scale 1:63,360, 1969.

05760 **Canada Geological Survey.** Aeromagnetic series, Dolland Brook, Newfoundland: Canada Geol. Survey Geophysics Paper 4494, scale 1:63,360, 1969.

05761 **Canada Geological Survey.** Aeromagnetic series, D'Espoir Brook, Newfoundland: Canada Geol. Survey Geophysics Paper 4495, scale 1:63,360, 1969.

05762 **Canada Geological Survey.** Aeromagnetic series, St. Alban's, Newfoundland: Canada Geol. Survey Geophysics Paper 4496, scale 1:63,360, 1969.

05763 **Canada Geological Survey.** Aeromagnetic series, Hungry Grove Pond, Newfoundland: Canada Geol. Survey Geophysics Paper 4497, scale 1:63,360, 1969.

05764 **Canada Geological Survey.** Aeromagnetic series, Gisborne Lake, Newfoundland: Canada Geol. Survey Geophysics Paper 4498, scale 1:63,360, 1969.

05830 **Cantelaube, Y.; Pellas, P.; Nordemann, D.; Tobailem, J.** Reconstitution de la météorite Saint-Séverin dans l'espace, Paper 58 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 705-713, illus., tables; discussion, p. 717, 1969.

Saint-Séverin amphoterite has the lowest ablation rate of all meteorites for which the rate has been determined. A geometric reconstruction is in good agreement with results from track densities of iron ions measured in hypersthene crystals on faces of fragments. From variation in track densities of heavy ions as a function of depth in the meteorite it has been possible to reconstruct the object in space. The face turned towards the atmosphere underwent greater ablation than the rear face; hence, Saint Séverin is an oriented meteorite. Loss in mass due to ablation has been determined with reference to the very low space erosion rate, evaluated from the very high track densities found on the shielded rear face. On assumption of an erosion rate <0.1 cm per 10^8 yr, ablation represents about 25 percent of the pre-atmospheric mass. — *from* Authors' abstract

06178 **Carlson, Clarence G.** Bedrock geologic map of North Dakota: North Dakota Geol. Survey Misc. Map 10, scale 1:1,000,000, text [1969?].

This map is a revision of a geologic map by M. Hansen, 1956. An inset generalized glacial map (scale about 1 in. to 38 mi.) shows extent of glacial deposits. A list of references is included on the sheet. — MCM

06213 **Carlson, Clarence G.** Deep oil and gas possibilities of the Nesson anticline area, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 27-31, illus., 1969.

For the Bakken-Three Forks Formations, many wells have shows, but the reservoir characteristics are poor. The Birdbear Formation has good reservoir characteristics,

but has not been very productive along this trend. The Duperow Formation is now productive in 12 of 24 pools, and the best prospects are in the Blue Buttes field and other areas of small closure. The Interlake Formation offers some hope for further development. The lack of Red River Formation production in Charlson and Antelope fields is discouraging, but recent success in the Tioga field is encouraging. The Winnipeg-Deadwood Formations, based on gas found in the Beaver Lodge field, have a possibility for future development. Gas is present in this unit in the Antelope field, but prohibitive depths and low yield have deterred development. — *from* Author's summary

Carmichael, I. S. E. *See* Jack, R. N. 06191

Carmichael, I. S. E. *See* Smith, A. L. 06348

06366 **Carpenter, Roy.** Factors controlling the marine geochemistry of fluorine: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1153-1167, illus., tables, 1969.

It is found that $CaCO_3$ precipitation dominates the removal of dissolved F from sea water, with incorporation into calcium phosphates apparently the next most important removal mechanism. An enrichment of F over Cl by a factor of about 10^5 occurs during $CaCO_3$ precipitation. The residence time of the F ion is calculated to be a few million years, F being removed from sea water about 100 times faster than Cl. Another important removal mechanism is the preferential injection of F into the atmosphere at the sea surface. The consequent atmospheric precipitation of this F accounts for the major part of the F found in rivers. Atmospheric precipitation also weathers crustal rocks, most of the F mobilized remaining bound in the solid phases such as the clays. It is found that these clays, on entering the sea, have very little effect on the F in solution there. — GV

06372 **Carrasco V., Baldomero.** Amonitas del Campaniano Inferior del norte de Coahuila: Soc. Geol. Mexicana Bol. 1967, v. 30, no. 2, p. 139-154, illus., tables, 1969.

Systematic descriptions are given of the following ammonites from the abundant fauna characterizing the top layer of the Dessau Formation in the Jimenez area, Coahuila: *Bevahites tovari*, n. sp., *B. internodosus* (Renz), *B. densinodosus* (Renz) (= *B. subquadratus* Collignon), *Submortoniceras rennei* (Collignon), and *Parapuzosia boesei* (Scott and Moore). Comparisons of *P. boesei* with the original description of *P. americana* Scott and Moore suggest revision of the holotype of *P. americana* because of shell deformation from compaction. — VSN

Carter, M. W. *See* Thurston, P. C. 06019

Carter, M. W. *See* Thurston, P. C. 06020

Carter, M. W. *See* Thurston, P. C. 06021

Carter, M. W. *See* Thurston, P. C. 06022

Carter, R. W. *See* Fleischer, R. L. 05749

05836 **Cayé, R.; Giraud, R.; Sandrea, A.** Phase métallique des météorites pierreuses (with English abs.), Paper 54 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 657-668, illus., tables; discussion, p. 715, 1969.

Results are reported of electron microprobe studies of reflecting power and chemical composition of minerals of the metallic phase of stone meteorites. Results for the chief minerals are grouped under: meteorites whose silicate phase contains olivine and pyroxene more or less rich in FeO and meteorites with enstatite and forsterite. In general, results show the close interdependence of optical characteristics and chemical composition, the extreme sensitivity of the first as a function of the second, and the variance of chemical compositions (in some cases) in one species in the body of the same meteorite and its optical adjustments. A brecciated chondrite, a recent oc-

tahedrite, and a metallic mineral ensemble taken from five meteorites of an enstatite-forsterite group were used in the study. — VSN

Ceplecha, Z. *See* McCrosky, R. E. 05841

05842 **Chamberlain, Von Del.** A network for rapid analysis of fireball trajectories, Paper 51 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 613-622, illus., 1969.

The network for observation of fireballs includes all planetariums in the United States (about 500) and, where few exist, other agencies. Standard data cards and procedures are used for rapid transmittal of data to headquarters. Each member interviews observers at the site of each observation and data are then telegraphed to headquarters; more complete data is mailed upon completion of work in each region. Data are analyzed at headquarters and accumulations are to be published at appropriate times. Possibilities for extension of this system on a worldwide basis are discussed on the basis of the worldwide distribution of planetariums. — VSN

Chamney, T. P. *See* Mountjoy, E. W. 05912

05846 **Chang, C.; Wänke, H.** Beryllium-10 in iron meteorites, their cosmic-ray exposure and terrestrial ages, Paper 33 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 397-406, illus., tables; discussion, p. 459-460, 1969.

Cosmic-ray-produced Be-10 has been determined in about 40 iron meteorites. Together with the values for Cl-36, and the stable cosmic-ray-produced rare-gas isotopes obtained previously in our laboratory from the same samples, exposure ages and in particular terrestrial ages, have been calculated for these meteorites. The most striking results of this investigation are the high terrestrial ages of many iron meteorites; mean terrestrial ages of the order of 10^8 yr are found with single species up to 2.7×10^8 yr old. Implications of these results in connection with geographic distribution of finds of iron meteorites are discussed, as well as reasons for distribution. Thirty-six percent of all finds of irons come from three very localized areas on the globe — the Appalachian Mountains, Arizona, and northern Chile. — *from* Authors' abstract

Chang, R. K. *See* Yong, R. N. 06298

Chapman, Sheri L. *See* Ralston, Dale R. 06187

Charlesworth, H. A. K. *See* Robinson, J. E. 05680

05686 **Chaudhuri, Sambhudas; Brookins, Douglas G.** The Rb-Sr whole-rock age of the Stearns Shale (Lower Permian), eastern Kansas, before and after acid leaching experiments: Geol. Soc. America Bull., v. 80, no. 12, p. 2605-2609, illus., tables, 1969.

Six untreated whole-rock samples of the Stearns Shale with low Sr-87/Sr-86 and Rb-87/Sr-86 ratios define a least squares isochron of 371 ± 15 m.y., using a 50 b.y. half-life for Rb-87. Treatment of the samples with 2N HCl with constant agitation for 15 minutes produced six samples of insoluble residue with much higher Sr-87/Sr-86 and Rb-87/Sr-86 ratios and a Rb-free leach of low Sr-87/Sr-86. Least squares analysis of the insoluble residue samples yields a 276 ± 10 m.y. isochron with initial Sr-87/Sr-86 of 0.7195 ± 0.0005. This age is close to the presumed age of the Lower Permian and suggests that this method may allow the accurate dating of some predominantly allogenic calcareous shales. — *from* Authors' abstract

05784 **Cheetham, Alan H.; Hazel, Joseph E.** Binary (presence-absence) similarity coefficients: Jour. Paleontology, v. 43, no. 5, p. 1130-1136, table, 1969.

Various numerical coefficients have been employed in comparisons of taxa or bioassociational units, especially in studies involving large arrays of multivariate data.

Nomenclatural and conceptual difficulties have arisen from the translation of coefficients from variable-oriented (R-mode) to case-oriented (Q-mode) use. This paper points out the conceptual relationships and some of the properties of coefficients expressing similarity or difference between units defined by binary data. — Authors' abstract

Chen, Kuang-Chian. *See* Chiu, Chao-Lin. 05969

05684 **Childs, Orlo E.** Ben H. Parker (1902-1969): Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2377-2378, portrait, 1969.

06031 **Chinnery, Michael A.** Earthquake magnitude and source parameters: Seismol. Soc. America Bull., v. 59, no. 5, p. 1969-1982, illus., table, 1969.

The fault parameters associated with a set of 27 earthquakes with strike-slip movement in the magnitude range 3.4-8.3 are used to test previously established empirical linear relations between earthquake magnitude (M) and the logarithm of one or more of the source parameters (length L, width W, displacement D). It is found that there is no linear relationship between M and log L or log W that is valid over the whole magnitude range, but that there is a rather good linear relationship between M and log D. Using all the data, this relation is $M = 1.32 \log D + 4.27$; using only large magnitude events this becomes $M = 1.04 \log D + 4.96$. The second formula may be closer to the truth. The consequences of such a relationship are discussed. — DBV

05969 **Chiu, Chao-Lin; Chen, Kuang-Chian.** Stochastic hydrodynamics of sediment transport: Am. Soc. Civil Engineers Proc., v. 95, paper 6858, Jour. Eng. Mechanics Div., no. EM5, p. 1215-1230, illus., 1969.

A stochastic model has been used in a study of sediment transport by the Monte Carlo simulation method. Results include the three-dimensional unsteady sediment distribution that cannot be obtained by conventional techniques, as well as the steady uniform sediment distribution. The diffusion coefficient of sediment is also studied by the simulation method used. Such a method should find its application in a study of the initial, transient, or unsteady mixing pattern of solid wastes released from a point source in a flow field. — ASCE abstract

Chojnacki, Richard. *See* Hummel, J. M. 06258

Chow, Tsaihwa J. *See* Morozumi, M. 06174

Church, D. *See* Boyle, R. W. 06313

06067 **Churkin, Michael, Jr.** Paleozoic tectonic history of the Arctic Basin north of Alaska: Science, v. 165, no. 3893, p. 549-555, illus., 1969.

The geology of the margin of the Canada basin, together with geophysical data, suggests that the basin is a true and probably very ancient ocean basin floored by oceanic crust and rimmed by an early Paleozoic geosynclinal belt. The sharp bend in the structural elements of southern Alaska (the Alaska orocline) may have been caused largely by spreading of the Pacific sea floor against the continental margin of the Gulf of Alaska. — DBV

Claerbout, Jon F. *See* Landers, Tom. 06007

Clark, Thomas. *See* High, Lee R., Jr. 06227

05744 **Clarke, Roy S., Jr.** Comments on cohenite and schreibersite in iron meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 161, 1969.

06193 **Cleveland, George B.** Rapid method of sampling diatomaceous earth, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 100, p. 67-68, illus., 1969.

A relatively rapid and simple method of sampling diatomaceous earth consists of impressing a strip of common plastic gummed tape against the surface of the diatomite and removing a thin layer of particles for microscopic examination. — Author's abstract

06303 **Cloud, Preston E., Jr.** The primitive Earth: New Scientist, v. 43, no. 662, p. 325-327, 1969.

An internal, juvenile source for the Earth's atmosphere and hydrosphere is generally accepted by Earth scientists. The time of origin, however, is not known, the minimum being that of the most ancient terrestrial minerals dated, 3.5 to 3.6 b.y. ago. For the atmosphere and hydrosphere to have been outgassed, the outer Earth would have had to undergo melting sufficient to release volatiles. This might have resulted from lunar capture aided by radiogenic heating, tidal friction, and conversion of gravitational energy to heat. Since free oxygen was generally absent in this primitive atmosphere, microfossils more than 3.2 b.y. old must have been anaerobic; for evolution to have continued, however, an autotrop must have appeared and was the most likely source of free oxygen through the process of photosynthesis. Living organisms and iron ores are shown to have played a major role in further evolution of the atmosphere. — VSN

06265 **Cloud, William K.; Scott, Nina H.** Distribution of intensity, Prince William Sound earthquake of 1964, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 5-48, illus., 1969.

Effects of the Prince William Sound Earthquake of 1964 are described in terms of eyewitness reports, and the effects evaluated from these and many other reports are summarized numerically on a map to roughly indicate distribution of intensity. From the map, the felt area of the earthquake is estimated approximately at 700,000 square miles and the damage area, exclusive of distant areas affected by tsunami and seiche action, about 80,000 square miles. — Authors' abstract

06096 **Cocke, J. M.** Taxonomic and environmental study of two dibunophyllid coral species from Upper Pennsylvanian rocks of Kansas: Kansas Univ. Paleont. Contr.-Paper 44, 11 p., illus., 1969.

Two externally similar species of Upper Pennsylvanian rugose corals *Dibunophyllum parvum* Cocke, n.sp., from the Wyandotte Formation, and *D. perplexum* Cocke, n.sp., from the Amazonia Limestone, Lawrence Formation, were studied for (1) taxonomic differentiation and (2) environmental significance. An objective test of numerical data from each species was made using discriminant analysis. Variation in dissepiment types and characters of the columella were most useful in specific assignment. On the basis of rock type and fossil analyses, specimens of *D. parvum* are considered representative of an *in situ* assemblage which grew in shallow, well-lighted marine waters with numerous other organisms. In contrast, *D. perplexum* shows evidence of being transported and sorted. — Author's abstract

Cockrell, C. F. *See* Muter, Richard B. 06124

06276 **Cole, W. Storrs.** Larger Foraminifera from deep drill holes on Midway atoll: U.S. Geol. Survey Prof. Paper 680-C, p. C1-C13, illus., tables, 1969.

Nine species of larger Foraminifera recovered from cores of two deep holes drilled on Midway atoll, Hawaiian Islands, are analyzed. The lower part of the deeper hole encountered two zones, one above the basalt characterized by *Spiroclypeus margaritatus* (Schlumberger) overlain by a zone containing *Miogypsinoides dehaartii* (van der Vlerk) and *Austrotrillina striata* Todd and Post. These zones correlate with Tertiary *e* (Miocene) of the western Pacific. The shallower hole and the upper part of the deeper hole have species of larger Foraminifera which are still living in the Hawaiian area and are known to have rather extensive stratigraphic ranges from Miocene to Holocene. The larger Foraminifera found on Midway atoll probably migrated there on rafts of vegetation from the western Pacific. — WSC

06080 **Collins, A. Gene; Wong, Chung-ming; Gillam, W. Sherman; Leiserson, Lee.** Solubilities of some silicate minerals in saline waters — U.S. Office Saline Water Research and Devel. Prog. Rept. 472: Washington, D.C., U.S. Govt. Printing Office, 27 p., illus., tables, 1969.

In the systems H_2O, H_2O-$CaCl_2$, H_2O-$MgCl_2$, H_2O-NaCl, and H_2O-$NaHCO_3$, the solubilities of illite, kaolinite, montmorillonite, nontronite, and a serpentine were determined as a function of time at ambient temperatures and pressures. The solubility of a serpentine was also determined in H_2O-$CaCl_2$ and H_2O-NaCl systems from 30° to 200°C and from 2,500 to 15,000 psi. The experimental data are illustrated with smoothed curves plotted from silicon molality versus hours. Empirical equations were derived from the smoothed data. — Authors' abstract

05835 **Comerford, M. F.** Phosphide and carbide inclusions in iron meteorites, Paper 63 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 780-795, illus., tables; discussion, p. 840-841, 1969.

Morphologies and mechanical properties of phosphides (schreibersite and rhabdites) and carbides (cohenite) are described and distinguishing features of the phases are emphasized; difference in mechanical properties can serve as a means of identification. The relation between metallographic observations and size distribution data is assessed to estimate phosphide nucleation temperatures in octahedrites. Measurements of flakes of schreibersite in several octahedrites show that size distribution in terms of flake thickness varies little from meteorite to meteorite. Morphology indicates that nucleation and growth of flake schreibersite occurred in grain boundaries and postdated Widmanstätten pattern formation. Rhabdites probably nucleated within kamacite plates and grew by lattice diffusion, and may be more reliable phosphides for diffusion analysis. — *from* Author's abstract

05996 **Condie, Kent C.** Petrology and geochemistry of the Laramie batholith and related metamorphic rocks of Precambrian age, eastern Wyoming — Reply [to discussion by S. B. Smithson and D. S. Hodge, 1969, of 1969 paper]: Geol. Soc. America Bull., v. 80, no. 11, p. 2385-2386, 1969.

Condie points out in reply to Smithson and Hodge (ibid., p. 2383-2384) that three summers were spent in the field making a reconnaissance geologic map and collecting a representative suite of samples for geochemical study, sufficient time to grossly understand the geology of the Precambrian rocks. The Laramie batholith is a "batholith" in terms of current usage by most petrologists – that is, a large granitic pluton or complex of plutons without genetic connotations. No evidence was found in the central complex to support the suggestion by Smithson and Hodge for an origin by melting of a volcanic-sedimentary terrane, although melting of such a terrane would be compatible with geochemical data reported by Condie. — VSN

06045 **Condie, Kent C.; Barsky, C. K.; Mueller, Paul A.** Geochemistry of Precambrian diabase dikes from Wyoming: Geochim. et Cosmochim. Acta, v. 33, no. 11, p. 1371-1388, illus., tables, 1969.

Major- and trace-element concentrations in contact zones of 27 Precambrian diabase dikes from several Wyoming ranges indicate that in general these dikes are continental tholeiites, depleted (relative to most young continental tholeiites) in Sr relative to Rb, K, Ca, and usually Ba, and enriched in Rb relative to K and sometimes Ba. These diabases define a fractionation trend in which Sr is rapidly depleted relative to Rb and K and enriched at a smaller rate relative to Ca as compared to normal-Sr trend of basalts. Data favor extensive plagioclase crystallization from Ca-Al-rich primary tholeiitic magmas. If such a model is valid, the distribution of tholeiites exhibiting a Sr-depletion trend may offer an indirect method of mapping the distribution of Ca-Al-rich ultramafic source areas in the upper mantle. —DBV

05967 **Conover, W. J.; Matalas, N. C.** Statistical model of turbulence in sediment-laden streams: Am. Soc. Civil Engineers Proc., v. 95, paper 6814, Jour. Eng. Mechanics Div., no. EM5, p. 1063-1081, table, 1969.

Turbulent flow in a sediment-laden stream is described by a random walk model which simulates behavior of sediment particles, fluctuating in depth near the surface down to the bed. Basic in this model is the probability law for transfer of mass, both water and sediment, from one level to another throughout the total depth. Downstream velocity at each level is introduced to convert mass to momentum; three sources of momentum loss are considered. Downstream velocities at various levels are determined from a set of equations based on the assumption that expected momentum at a given level equals the sum of expected momentum contributed at Δt previous from all levels and by gravity. Solution of these equations in the limit of zero distance between levels leads to vertical velocity distribution of the sediment-water mixture dependent upon four parameters. — *from* ASCE abstract

Cooper, Hilton H., Jr. *See* Pinder, George F. 06318

Cooper, J. F., Jr. *See* Dunning, G. E. 05986

05856 **Corgan, James X.** New name for *Vitrinella tenuisculpta* Aguayo and Borro (Gastropoda): Jour. Paleontology, v. 43, no. 5, p. 1298, 1969.

Solariorbis aguayoi is offered as a replacement name for *Vitrinella tenuisculpta* Aguayo and Borro, 1946, which is preoccupied by *V. tenuisculpta* Carpenter, 1865. The renamed species, known only from the Miocene of Cuba, is here placed in the vitrinellid genus *Solariorbis* Conrad, 1865, on the basis of reticulate microsculpture. — RCD

Crittenden, Max D., Jr. *See* Wallace, Chester A. 06354

Cronoble, William R. *See* Kinard, John C. 06214

05745 **Crowson, Henry L.** A method for determining the residual meteoritical mass in the Barringer Meteor Crater [abs.]: Meteoritics, v. 4, no. 3, p. 163, 1969.

06169 **Cserna, Zoltán de.** Tectonic framework of southern Mexico and its bearing on the problem of continental drift [with Spanish summ.]: Soc. Geol. Mexicana Bol. 1967, v. 30, no. 2, p. 159-168, illus., 1969.

The abrupt and anomalous juxtaposition of rock sequences and their structures in southern Mexico with oceanic crust along the Mexican segment of the Mexico-Mesoamerica Trench can be explained only by large-scale faulting which permitted chopping off this southern extreme of the continent. Regional geologic evidence suggests that the rocks of the Nicoya Peninsula of Costa Rica may be the closest southeastward continuation of the eugeosynclinal portion of the Mexican Structural Belt. Local evidence permits only the consideration of post-early Eocene and more probably post-middle Miocene faulting. This transcurrent and vertical faulting no doubt formed an integral part of the Central American fracture system that resulted from the differential movements between North and South America during encroachment on the Pacific Basin. — *from* Author's abstract

06179 **Cserna, Zoltán de.** Minerales para fertilizantes en México: Soc. Geol. Mexicana Bol. 1967, v. 30, no. 2, p. 169-172, illus., tables, 1969.

The geologic occurrence, genesis, reserves, and production in Mexico of minerals important in production of fertilizers are discussed. Commodities examined are phosphates, sulfur, potassium, gypsum, and nitrates. The probable and possible locations of deposits of these commodities are shown on maps. — VSN

06221 **Culbertson, William C.** Facies changes in the Eocene rocks in the southeastern part of the Green River basin, Wyoming, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 205-211, illus., 1969.

During the early Eocene in the area of the southeastern Green River basin, coarse clastics were deposited near the mountains and finer clastics were deposited farther to the north. Swamps, resulting in formation of coal, limestone, and oil shale, were present also. The lakes in these swampy areas fluctuated in size. In the middle Eocene, volcanoes to the north were the primary source of material deposited in the lakes; the Uinta Mountains were contributing little or no material to the basins at this time. Precambrian clasts in earliest early Eocene rocks to the east and their absence in Eocene rocks as young as middle Eocene in the west suggest that the differential uplift and erosion of the Uinta Mountains began in the east and also resulted in varying facies in the Eocene rocks to the north. — HRC

Currie, K. L. *See* Murtaugh, J. C. 06168

Dachille, Frank. *See* Gigl, Paul D. 05756

05993 **Dahlstrom, C. D. A.** The upper detachment in concentric folding: Bull. Canadian Petroleum Geology, v. 17, no. 3, p. 326-346, illus., table, 1969.

During concentric folding the deformed rocks are divided into two or more discrete structural units. In the Fernie Basin area the internal structure and both boundaries of one concentrically folded panel can be studied. This structural-lithic unit is separated from the overlying rocks by a decollement and from the underlying rocks by a major thrust which probably was a decollement during folding. Recognizing these relationships requires the application of the principle of down-plunge projection. — Author's abstract

05933 **Dasch, E. Julius, Jr.** Strontium isotopes in weathering profiles, deep-sea sediments, and sedimentary rocks [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1751B, 1969.

Dass, A. S. *See* Boyle, R. W. 06313

06203 **Davies, David K.; Berg, Robert R.** Sedimentary characteristics of Muddy barrier-bar reservoir and lagoonal trap at Bell Creek field, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 97-105, illus., 1969.

Barrier-bar reservoir and lagoonal trap sediments at Bell Creek field, Montana, may be recognized readily through a study of sedimentary structures and textures. These sedimentary characteristics are identical to those of modern barrier complexes of the Texas Gulf Coast. A precise knowledge of the characteristics is essential to the future exploration for similar barrier-bar oil fields. — Authors' conclusions

05782 **Davis, James F.** Uranium deposits of the Powder River Basin, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 131-141, illus., 1969.

Uranium in the basin is in the form of geochemical roll fronts associated with decrease in permeability in arkosic sandstones of the Wasatch Formation. Previously mined deposits were mostly oxidized, but recent discoveries are more extensive unoxidized bodies. Source of uranium is postulated to be Tertiary tuffs which once covered the area. Hydrolysis of the tuffs produced alkaline ground water which dissolved uranium and carried it as a tricarbonate. The transmissive sand units carrying the solutions were stained pinkish-red by hematite. Cores of unaltered arkose contain less than two ppm U, whereas cores from back in the altered zone contain 18 ppm U. Ore deposits are usually multiple C-shaped rolls, ranging in thickness from 2 to 20 feet, and several thousand feet in length. Protore up to 40 feet thick is often present on the unaltered side of a high-grade roll front. [Generalized sections are included.] — *from* Author's abstract

Davis, Nicholas F. *See* Burnham, C. Wayne. 05973

Davis, Stanley N. *See* ElBoushi, Ismail M. 06036

06054 **deBoer, Jelle; Schilling, Jean-Guy; Krause, Dale C.** Magnetic polarity of pillow basalts from Reykjanes Ridge: Science, v. 166, no. 3908, p. 996-998, illus., 1969.

A first attempt to measure directly the magnetic polarity of submarine basalts dredged from the Reykjanes Ridge indicates that the first two magnetic anomalies over the ridge resulted from a reversal of the Earth's magnetic field. Volcanic criteria were used to determine the orientation the samples had before they were dredged from the sea floor. — Authors' abstract

05911 **Deep Sea Drilling Project.** (Scientific Staff). Joides Deep Sea Drilling Project Leg 3 and Leg 4: Geotimes, v. 14, no. 6, p. 13-16, illus., table, 1969.

On Leg 3, 10 sites were investigated in the South Atlantic Ocean, mainly on the Mid-Atlantic Ridge. Drilling at each site was deep enough to reach the basalt basement. On Leg 4, nine sites were drilled in the western South Atlantic and Caribbean region. The objectives were to enhance knowledge of basins adjacent to continental margins, sea-floor spreading, nature of the transverse fractures of the Mid-Atlantic Ridge, geology of island arcs and trenches, and to explore the geologic history of the Caribbean. Cores described include those from two sites off the Lesser Antilles, and three in the Caribbean, in the central Venezuela Basin. — ESL

DeGeer, Myron W. *See* Galegar, William C. 05977

Degens, Egon T. *See* Hathaway, John C. 06308

Demirel, Turgut. *See* Noble, Calvin A. 06290

05934 **Demirmen, Ferruh.** Petrographic and statistical study of part of Pennsylvanian Honaker Trail Formation, southeastern Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1751B, 1969.

Dence, M. R. *See* Hartung, J. B. 05712

06126 **Denison, R. E.; Hetherington, E. A., Jr.; Otto, J. B.** Age of basement rocks in northeastern Oklahoma: Oklahoma Geology Notes, v. 29, no. 5, p. 120-128, illus., tables, 1969.

Twelve new Rb-Sr ages have been determined on feldspar, muscovite, and whole rock of 10 Precambrian basement samples from wells in northeastern Oklahoma and adjacent areas of Kansas and Missouri. Isochron plots of Sr-87:Sr-86 vs. Rb-87:Sr-86 are constructed from the new ages alone and in combination with published data (Denison et al, 1966; Muehlberger et al., 1966, 1967). Age of the Spavinaw igneous activity (rhyolites and Spavinaw-Woodson type granites) is redefined as 1,250 ± 20 m.y., with initial Sr-87:Sr-86 ratio of 0.7040 ± 0.0010. This calculation differs significantly from the original isochron of 1,200 ± 30 m.y. (Muehlberger et al., 1966), and supports age equivalence with a major period of igneous activity, 1,244 m.y., in the St. Francois Mountains of southeastern Missouri (Bickford and Odom, 1967; J. E. Anderson et al., 1969). — VMJ

06319 **Denison, R. E.; Hetherington, E. A., Jr.** Rb-Sr ages from the Franklin Mountains, *in* The Ordovician symposium-El Paso Geol. Soc., 3d Ann. Field Trip, 1969: El Paso, Tex., El Paso Geol. Soc., p. 7, 1969.

Eight igneous rocks from the Franklin Mountains (Texas and New Mexico) yield Rb-Sr age dates ranging from 905 ± 20 m.y. to 990 ± 50 m.y. — KAF

Dennen, W. H. *See* Blackburn, W. H. 05770

DeNoyer, J. M. *See* Hamilton, R. M. 06189

06375 **Depman, A. J.; Parrillo, D. G.** Geology of Tocks Island area and its engineering significance, Field Trip 5 (cont'd.) *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., At-

lantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 354-362, illus., tables, 1969.

Just upstream from Shawnee, Pa., where the Delaware River flows in a U-shaped valley, is a broad SW-plunging asymmetric syncline with SE-dipping axial plane, its trough beneath deep Pleistocene deposits on the Pennsylvania bank. On the New Jersey side, in the flank of Kittatinny Mtn., the High Falls Formation (Silurian) dips about 45° riverward. Near its gradational contact with overlying Poxono Island formation, the bedrock surface plunges sharply, then rises gently beneath the river to steepen on the other side, where Devonian rocks crop out at a 450-ft elevation. Alluvium veneered glacial deposits up to 250 feet thick, weathered to depths of 10 feet to form an impervious blanket, overlie the bedrock beneath the river and most of the dam site in Pennsylvania. Detailed stratigraphic descriptions and engineering significance of the rock types are tabulated. — GDC

06008 **Derr, John S.** Free oscillation observations through 1968: Seismol. Soc. America Bull., v. 59, no. 5, p. 2079-2099, illus., tables, 1969.

All observations of the free oscillations of the Earth published through 1968 are weighted to produce a set of means and standard errors of the means. Fundamental orders 0 to 97 for spheroidal and 2 to 99 for torsional are treated, as well as many overtones up to order 49. Statistical tests indicate that some observations are path dependent at the 99 percent confidence level. Comparison of these means and standard errors with published Earth models indicates that they form a consistent basis for inversion of free oscillation observations to infer Earth structures. — Author's abstract

05926 **Desai, Chandrakant S.** Solution of stress-deformation problems in soil and rock mechanics using finite element methods [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1670B, 1969.

deWys, E. Christian. *See* Trueb, Lucien F. 06057

06283 **Dicke, R. H.** Average acceleration of the Earth's rotation and the viscosity of the deep mantle: Jour. Geophys. Research, v. 74, no. 25, p. 5895-5902, illus., tables, 1969.

The acceleration of the Earth's rotation averaged over the past 3,000 yr has been restudied using a new analysis of the ancient eclipses. The relaxation time for a second-order harmonic distortion of the Earth has been calculated to fall in the range 870-1,600 yr. This short relaxation time seems to require a viscosity for the deep mantle of approximately 10^{22} poises, permitting the convective transport of heat from the deep interior of the Earth. If the viscosity is this low, deep convective currents are required to support the excess equatorial bulge. — Author's abstract

Dillinger, W. H., Jr. *See* Algermissen, S. T. 06268

06271 **Dillinger, William H., Jr.; Algermissen, S. T.** Magnitude studies of Alaska earthquakes, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 175-183, illus., tables, 1969.

Comparisons of M_L, M_s, and m_b are presented for the main shock and aftershocks of the Prince William Sound Earthquake of March 28, 1964 (G.M.T.), and for other selected south-central Alaskan and Aleutian Island earthquakes. Earthquakes with m_b magnitudes between 5 and 6 have corresponding surface-wave magnitudes in the range of 4 to 7. Least-squares straight-line equations are given for all comparisons. — Authors' abstract

06134 **Dimroth, Erich.** Geology of the Castignon Lake area, New Quebec Territory [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 571, 54 p., tables, geol. maps, 1969.

The map-area, comprising three map-sheets—Mistamisk Lake, Brèche Lake, and Lace Lake — offers an almost complete cross-section through the Precambrian Labrador trough, for which a stratigraphic terminology is offered and tentative correlations made. A map shows type localities of the Alder and Uvé Formations. About 450 stream sediment samples were collected and analyzed for metals. The normal trace-element contents are tabulated and maps show the survey results. The area is favorable for prospecting, especially for iron and copper, but not for nickel, chromium, and asbestos which occur in other parts of the trough. — ESL

06148 **Dionne, Jean-Claude.** Bibliographie annotée du glaciel—Aspects morpho-sédimentologiques *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 339–349, 1969.

This bibliography contains 230 entries arranged alphabetically, but with no index. The annotations are a sentence or so long, and deal entirely with glacial-ice sedimentation. — HRC

Dionne, Jean-Claude. *See* Laverdière, Camille. 06150

06151 **Dionne, Jean-Claude.** État de la cartographie des formations meubles au Québec, *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 368–374, illus., tables, 1969.

This is a progress report on the mapping of surficial formations in Quebec, primarily in the south. The work is being done by geologists of the Commission géologique du Canada, and maps are being prepared at regular intervals. To date, there are 21 maps completed at a scale of 1/63,360 of unconsolidated materials, 39 of morphosedimentological features at a scale of 1/50,000, and 16 of specific areas dealing with superficial formations at a scale of 1/50,000. There are 23 maps in preparation of surficial material at a scale of 1/63,360, and 28 of morphosedimentological features at a scale of 1/50,000. — HRC

06152 **Dionne, Jean-Claude.** Note sur un éboulis récent à Saint-Febien-sur-Mer, côte sud du Saint-Laurent, *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 365-368, illus., 1969.

A rockfall from a steep cliff at Saint-Fabien-sur-Mer is described. Gravity was certainly the chief agent, and triggering devices are considered. Freezing and thawing and solution are not considered as likely as is thunder. A severe storm occurred in the area at the time, and the joints in the rocks were such that freezing and thawing would have loosened them and prepared them for fall with the thunder clap. — HRC

06154 **Dionne, Jean-Claude.** Nouvelles observations de fentes de gel fossiles sur la côte sud du Saint-Laurent [with French and German abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 307-316, illus., table, 1969.

Three main types of ice-wedges were observed: wide and short wedges, deep and narrow wedges, and deep and wide wedges. Most structures are filled with sediments coarser or smaller than those of the deposits in which they are cast and contain standing pebbles and a few layers bent downwards. These were made about 11,500-12,500 years ago during the St. Antonin glacial episode and are therefore related to the retreating ice front and not to the existence of a periglacial climate since glaciation. To date, no true fossil ice-wedge has been reported in Quebec north of the St. Lawrence, and not even north of the Highland Front moraine. — *from* Author's abstract

06356 **Dionne, Jean-Claude; Laverdiere, Camille.** Sites fossilifères du Golfe de Laflamme [with English and Russian abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 259-270, illus., tables, 1969.

Since the 1956 paper dealing with what was known about the Postglacial marine transgression which came through the Saguenay fjord up to Lake St-Jean and which formed the Laflamme Gulf, new geomorphology and Quaternary geology research

have unravelled numerous new fossiliferous sites. Up to that date, the following molluscs were known in the Lake St.-Jean area: *Hiatella arctica*, *Macoma balthica*, *Mya arenaria* and *Portlandia arctica*. In this paper, the authors review in the literature the sites known prior to 1949 and indicate the sites visited since then. Several dates have led to bracketing the age of the fossils between 9,930 and 8,630 years B.P. The paper discusses also the use of the generic word *Gulf* (of Laflamme). —Authors' abstract

Djuricic, Milica V. *See* Murphy, Robert C. 06068

05834 **Doan, A. S., Jr.; Goldstein, J. I.** The formation of phosphides in iron meteorites, Paper 62 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 763-779, illus., tables; discussion, p. 840, 1969.

The iron-rich corner of the Fe-Ni-P phase diagram has been redetermined between 1100° and 650°C to determine the necessary conditions for formation of phosphide minerals in iron meteorites. Results are applied to various types of iron meteorites to describe the necessary conditions to yield the diversity of shape and Ni composition of schreibersite and rhabdite. From results it can be inferred that thermal equilibrium is maintained in iron meteorites to cooling temperatures of 650°C. Phosphorus contents determined chemically for meteorites containing macroscopic phosphides are grossly underestimated. Data on P content of 11 octahedrites and one ataxite were obtained by a point count method. — *from* Authors' abstract

Dodge, F. C. W. *See* Naeser, C. W. 05885

05687 **Doe, Bruce R.; Pearson, Robert C.** U-Th-Pb chronology of zircons from the St. Kevin Granite, northern Sawatch Range, Colorado: Geol. Soc. America Bull., v. 80, no. 12, p. 2495-2502, illus., tables, 1969.

Three zircon samples from the St. Kevin Granite, northern Sawatch Range, Colo., were analysed for uranium, thorium, and lead content and for lead isotopic composition. The concordia age on the zircons of 1420 ± 40 m.y. is in good agreement with a Rb-Sr whole-rock isochron age of 1470 m.y. for this granite, which apparently formed in large part by local melting of crustal rocks similar to the present wall rocks. Isotopic evidence that the zircons were derived from older rocks is inconclusive, but Pb-Pb ages of two nearly concordant zircons differ by 1.9 percent. This suggests a possible xenocrystic component in the zircon populations. The zircons, if xenocrysts, apparently were almost entirely recrystallized or else lost nearly all their lead to the melt by diffusion. — RWK

05820 **Dollase, W. A.** Crystal structure and cation ordering of piemontite: Am. Mineralogist, v. 54, nos. 5-6, p. 710-717, tables, 1968.

The crystal structure of the Mn^{3+}-bearing epidote, piemontite, has been refined. For a crystal of composition, $Cz_{65}Pm_{24}Ps_{11}$, refinement of the occupancies of the two large, nominally calcium sites and the three non-equivalent octahedral sites, gives: $(Ca_{1.00})$ $(Ca_{0.87}Sr_{0.13})(Al_{0.80}M_{0.20})(Al_{1.00})(Al_{0.17}M_{0.83})Si_3O_{12}OH$, where M = $Mn_{0.7}Fe_{0.3}$. All of the (Mn,Fe) substitution for Al occurs in one of the two nonequivalent chains of edge-sharing octahedra. In the substituted chain, which is topologically identical with that found in the olivine structure, the larger M(3) site (symmetry-*m*) lying on the edge of the chain, contains most of the (Mn,Fe) with lesser amounts in the smaller M(l) site (symmetry-$\bar{1}$) which forms the core of the chain. — Author's abstract

Donnay, G. *See* Thorpe, A. N. 06079

06055 **Donnay, Gabrielle; Pawson, David L.** X-ray diffraction studies of echinoderm plates: Science, v. 166, no. 3909, p. 1147-1150, illus., tables, 1969.

X-ray diffraction studies confirm that, with few exceptions each skeletal element of echinoderms is a single crystal of magnesium-rich calcite and that a relation exists between the shape of the element and the crystallographic a- and c-axes. The excep-

tions include the teeth of echinoids, and the calcareous ring as well as the anal teeth of holothurians. The tubercles of an echinoid plate begin their growth as parts of the single crystal of the plate; under the mechanical action of the spines that are attached to them, they become partly polycrystalline, as shown by scanning electron microscopy and by X-ray powder diffraction. The interface between inorganic crystalline and organic amorphous matter in the skeletal element appears to be the first example reported in nature of a periodic minimal surface. — Authors' abstract

05837 **Dörfler, G.; Hlesböck, H. G.** Investigations on a quantitative mineralogical characterization of meteorites by modal analysis, Paper 55 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 669-682, illus., tables; discussion, p. 715, 1969.

Automatic modal analysis using an electron-microprobe is applied to the mineralogic characterization of chondrites. The following structural parameters are given for each meteorite: the volume fractions of the most important phases, the mean particle size of these phases, their surface area/unit volume, their grain-size distribution, and the proximity values between important phases. The latter is a new parameter which describes the distribution of phases relative to each other, particularly the measure for the contact area between certain phases. The interpretation of the data in the sense of the chemical-mineralogic classification of Wood and Van Schmus is attempted. — *from* Authors' abstract

Dorman, James. *See* Lammlein, David R. 05894

06051 **Dott, R. H., Jr.** Circum-Pacific late Cenozoic structural rejuvenation — Implications for sea floor spreading: Science, v. 166, no. 3907, p. 874-876, illus., 1969.

The hypothesis of sea-floor spreading and lithosphere plates seems to unify the origins of both oceanic ridges and volcanic arc-trench systems; therefore knowledge of well-known land areas should shed light upon sea-floor tectonics. Impressive evidence of a major mid-Cenozoic discontinuity in the tectonic history of circum-Pacific land areas suggests a roughly synchronous change in sea-floor development, more evidence for which may be anticipated in the future. — Author's abstract

06170 **Dott, Robert H., Sr.; Reynolds, Merrill J.** (compilers). Sourcebook for petroleum geology: Am. Assoc. Petroleum Geologists Mem. 5, 471 p., illus., 1969.

This sourcebook is divided into: *Genesis of petroleum*, and *Migration and accumulation of petroleum*. The purpose and plan of the volume, to present the various concepts that form the basis of the science and art of petroleum geology, is accomplished largely by direct quotation for authors of earliest and best statements of different concepts, and by quotations from later writers, tracing development of ideas and evolution of thought down to the present time. Quotations are connected with comment and discussion by the compilers. A certain amount of subjectivity is inevitable, as many of the concepts are still highly controversial. Each part contains an introduction (by H. D. Hedberg, and F. R. Clark), an epilogue, and an extensive bibliography. Part 1 includes an appendix, *Glossary of chemical terms*, by E. W. Biederman, Jr. Author and subject indexes are included. — MCM

05927 **Douglas, Arthur Gordon.** Soil deformation rates and activation energies [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1670B-1671B, 1969.

05747 **Douglas, J. A. V.; Plant, A. G.** Amphibole — First occurrence in an enstatite chondrite [abs.]: Meteoritics, v. 4, no. 3, p. 166, 1969.

06097 **Drake, Avery Ala, Jr.** Precambrian and lower Paleozoic geology of the Delaware Valley, New Jersey-Pennsylvania, Field Trip 1-A *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann.Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 51-131, illus., tables, 1969.

The Delaware River, flowing across regional strike, exposes Precambrian uplands known locally as the Reading Prong or New Jersey Highlands, and Cambrian-Ordovician strata in intermontane valleys within the Prong, and in the Great Appalachian Valley. Their geometric and tectonic relations are major problems. Petrologically unlike the Blue Ridge and Green Mts., but much like the Adirondacks and Canada's Grenville province, the Precambrian rocks are allochthonous. The flanking lower Paleozoic miogeosynclinal deposits show distinct deformational differences in various tectonic units; a fold nappe with Precambrian core is favored as the explanation. Principal rock types are described in stratigraphic units, with modal analyses; geologic sketch maps show their distribution; and comparative correlations are made. — GDC

Dreschhoff, G. *See* Zeller, E. J. 05859

05809 **Drever, James I.** The separation of clay minerals by continuous particle electrophoresis: Am. Mineralogist, v. 54, nos. 5-6, p. 937-942, illus., 1969.

A Beckman Continuous Particle Electrophoresis System is capable of separating mixtures of kaolinite and montmorillonite into five or more fractions by one pass through the instrument. The lowest and highest mobility fractions obtained from a 50:50 artificial mixture of these clays contain, respectively, 85 percent montmorillonite/15 percent kaolinite, and 5 percent montmorillonite/95 percent kaolinite. The intermediate fractions contain varying proportions of the two minerals. Mixtures of clays in Recent sediments can also be separated, but not as effectively as artificial mixtures. The most complete separation was obtained in a 4×10^{-4}M Na_2CO_3 buffer containing 5 percent ethylene glycol at pH 10. — Author's abstract

Drew, Isabella M. *See* Kerr, Paul F. 06190

05935 **Drew, Isabella Milling.** Properties of the Bootlegger Cove clay of Anchorage, Alaska [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1752B, 1969.

06005 **Duffield, Wendell A.** Petrology and structure of the El Pinal Tonalite, Baja California, Mexico — Reply [to discussion of 1968 paper by C. J. Talbot, 1969]: Geol. Soc. America Bull., v. 80, no. 11, p. 2391-2392, 1969.

Duffield in reply to Talbot (ibid., p. 2387-2389) emphasizes that even if his ring fracturing hypothesis is not the only explanation for the structures observed in the El Pinal Tonalite, it is the most probable explanation. Talbot's thermal convection model leaves poorly explained or unexplained the compositional zoning, the location of a major annular drainage channel, and the depth at which the exposed level was emplaced. The depth of emplacement implicit in the ring fracture model will be developed in detail in a manuscript now in preparation. Field data suggest that the pluton is epizonal and the ring-fracture model is sympathetic with this; in addition, a 1.5-mile depth of emplacement is suggested by a comparison of chemical composition of El Pinal aplites with experimental data of Tuttle and Bowen (1958). — VSN

06188 **Dunlop, David J.; West, Gordon F.** An experimental evaluation of single domain theories: Rev. Geophysics, v. 7, no. 4, p. 709-757, illus., tables, 1969.

The Néel theory of magnetization relaxation has been systematically and quantitatively tested for six samples containing synthetic and natural single domain grains. Results of experiments involving time, temperature, and direct and alternating magnetic fields were compared with theoretical results predicted by using Néel theory and experimental grain size-coercivity distribution of each sample. Good agreement was found for experiments involving small field remanences, where grain interaction effects are negligible. Most discordant results could be explained by using Preisach theory or an extended form of the Néel; the two methods are shown to be equivalent but the Néel theory is more useful in analyzing thermal processes. Similarity of behavior of synthetic and natural samples suggests that monodomain material is important in many rocks. — *from* Authors' abstract

05986 **Dunning, G. E.; Cooper, J. F., Jr.** Letovicite from The Geysers, Sonoma County, California: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 8, p. 135, 1969.

A fine-grained mass of platy, colorless, pseudohexagonal crystals found with massive mascagnite collected from The Geysers in 1962 has been identified by X-ray methods as letovicite. Specimens discovered earlier were formed during burning of coal-mine waste heaps. — ESL

Duquette, D. J. *See* Uhlig, H. H. 05730

Durham, C. *See* Boyle, R. W. 06313

Dyck, W. *See* Boyle, R. W. 06313

06223 **Eardley, A. J.** Early Tertiary volcanism near west end of Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 219-220, illus., 1969.

Early Tertiary volcanic-material bearing formations near the west end of the Uinta Mountains are the Fowkes (Eocene) with the source the Park City volcanic field, the Wasatch or Knight Formation west of Bear River (Eocene), and the Aspen (Lower Cretaceous) with the material coming from the Mesocordilleran geanticline. The Tertiary material seems distinct and to be from a different source. The Park City volcanic field and the Fowkes Formation are discussed; the Park City material occurs in isolated but large masses west of the Uintas; the Norwood Tuff is of similar composition and can be traced around the range to the Evanston, Wyo., area where it is seen to be part of the Fowkes Formation. Hence, the Fowkes lies above the Wasatch, not within it, as earlier suspected. — HRC

05887 **Easterbrook, Don J.** Pleistocene chronology of the Puget lowland and San Juan Islands, Washington: Geol. Soc. America Bull., v. 80, no. 11, p. 2273-2286, illus., tables, 1969.

The Pleistocene sequence includes the Whidbey Formation which was deposited prior to 40,000 yr ago and perhaps correlates with Puyallup and Sangamon Interglaciations of the U.S. Possession Drift, deposited between 35,000 and >39,900 yr B.P. is correlated with late Zyriansk Glaciation in Russia and early Würm in Europe. Olympia Interglaciation is between 23,000 and 27,000 yr old and is correlated with Farmdalian of U.S. and Karginsk Interglaciation of Russia. Esperance Sand (Vashon Stade) is C-14 dated at 18,000 ± 400 yr, and Everson Interstade at 10,370 ± 300 to 13,010 ± 170 yr ago. Sumas Stade ended shortly before 9,920 ± 760 yr ago. The last three units are parts of the Frazer Glaciation which correlates with Sartan Glaciation of Russia and part of the Main Würm of Europe. — HCW

Eaton, J. P. *See* Pakiser, L. C. 06047

Eberhardt, P. *See* Bochsler, P. 06337

06252 **Edgar, A. D.; Mottana, A.; Macrae, N. D.** The chemistry and cell parameters of omphacites and related pyroxenes: Mineralog. Mag., v. 37, no. 285, p. 61-74, illus., tables, 1969.

The cell dimensions of 55 pyroxenes have been determined or taken from literature; 22 are new. Using a modification of Troeger's (1962) method of recalculating chloromelanite analyses the present analyses were recalculated into the diopside-jadeite-acmite and diopside-jadeite-hedenbergite molecules and compared with their determined cell parameters. Because of gradations in all parameters, determination of compositions based on cell parameters can only be made within wide limits. Using a method of projection of compositions from acmite and hedenbergite apices to the diopside-jadeite join the ratios of diopside to jadeite can be determined for most samples to within ± 5 mol percent, and this permits an approximate estimate of omphacite compositions. — *from* Authors' summary

06205 **Edmisten, Neil; Foster, Norman H.** Weldon field, McCone County, Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 137-142, illus., 1969.

Weldon, the first field to obtain commercial production from the Kibbey Formation, is unique because of the rare tectonic and stratigraphic history which combined to form the trap and the hydrocarbon accumulation. Entrapment was a result of the regional westward truncation of the pay section, the development of a tight updip barrier, and the formation of a structural nose. The time and mechanism of development of the barrier or "channel" and the source of the oil cannot yet be resolved. The Kibbey has widespread porosity and oil shows, and it is anticipated that additional production will be found in this formation, but without the complicated history present at Weldon field. — *from* Authors' conclusions

Ehmann, W. D. *See* Morgan, J. W. 06161

Ehrlinger, H. P., 3d. *See* Leamnson, R. N. 06078

06036 **ElBoushi, Ismail M.; Davis, Stanley N.** Water-retention characteristics of coarse rock particles: Jour. Hydrology, v. 8, no. 4, p. 431-441, illus., 1969.

Water is retained on large particles of nonporous rock as a film of water about 0.1 mm thick on rock surfaces, as 0.006 to 0.180 ml droplets held at contact points between adjacent particles, and as small puddles of water on the upper surfaces of the rock. Water retained at contact points accounts for most of the water stored within aggregates of particles with diameters smaller than 30 mm. Whereas with diameters larger than 100 mm, water retained on the rock surfaces, particularly water puddled on top of the rock, accounts for most of the water. Infiltrating water will not wet all the rock surfaces. More than 50 percent of the surfaces may be dry at depth. The total amount of rainfall needed to initiate ground-water recharge in many areas having coarse rock particles at the surface is probably less than 1.0 cm. — Authors' abstract

05999 **Elders, Wilfred A.; Rucklidge, John C.** Layering and net veining in hornblende lamprophyre intrusions from the coast of Labrador: Jour. Geology, v. 77, no. 6, p. 721-728, illus., 1969.

Many flat to gently dipping dikes of hornblende lamprophyre southeast of Cape Harrison, Labrador, though less than 10 m thick, show layering parallel to their walls. Layering is absent in dikes steeper than 30°. Layering, in one dike traceable for more than 300 m, is given by isomodal increases in grain size upward or downward; other results from variations in hornblende:plagioclase ratios, from normal and reverse density grading, and from equant and acicular hornblende crystals. Disturbed and net-veined layers lie adjacent to undisturbed layers in some dikes. A complex process of repeated injection of magmas that differentiated by crystal settling as they moved almost horizontally seems to have operated. Later surges of magma caused filter pressing and net veining. — *from* Authors' abstract

ElGoresy, A. *See* Kullerud, G. 05718

06333 **ElGoresy, A.; Kullerud, G.** Phase relations in the system Cr-Fe-S, Paper 53 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 638-656, illus., tables; discussion, p. 714, 1969.

Phase relations were determined in the systems Cr-S and Cr-Fe-S and physical chemical conditions of formation of meteoritic sulfide assemblages, of which daubréelite is a constituent, were correlated with assemblages containing other chromium sulfides in which daubréelite is absent. Results demonstrate that the daubréelite+Mss_I+α $FeCr_{2s}$ assemblage originates at relatively low temperatures from Cr-poor monosulfide mix-crystals. Presence of Mss_I + Mss_{II} in the 40-60 percent ratio as in Obernkirchen and Russel Gulch meteorites may indicate rapid cooling to temperatures below 700° C. However, presence of Ni in solid solution forming $(Cr, Fe, Ni)_{1-x}S$ mix-crystals may prevent establishment of the daubréelite+α $FeCr_{2s}$ assemblage since $Fe_{1-x}S$-$Ni_{1-x}S$ solid solution is complete down to 300°C. — VSN

05708 **ElGoresy, Ahmed; Grögler, Norbert; Ottemann, Joachim.** Djerfisherite from the Pena Blanca Spring and Toluca meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 180, 1969.

Ellis, M. J. *See* Robinson, J. E. 05680

06215 **Elmer, N. C.** Oil and gas exploration potential of the Devonian of southwestern Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 45-52, illus., 1969.

Porous and permeable reservoir rocks occur in the Jefferson Dolomite, oil and gas shows occur as petroliferous dolomites and oil shows in some wells, the Three Forks Shale would make a good cap rock, and traps could occur in the "sheepherder" anticlines flanking the basins. Since over 19,000 feet of Devonian and pre-Devonian rocks occur in the miogeosyncline and the Beaverhead positive occurs at the proper time in the tectonic sequence, the area is considered a good potential petroleum province. — *from* Author's summary

06158 **Elson, John A.** Late Quaternary marine submergence of Quebec [with French and German abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 247-258, illus., 1969.

The earliest submergence was in the Gulf and the St. Lawrence estuary from about 13,000-10,000 years ago. The Champlain Sea occupied the upper St. Lawrence and Ottawa valleys from about 12,000-10,000 years ago. Lake St. John area was flooded by the Laflamme Sea from about 10,300-8,700 years ago, as were parts of the coast in the Ungava Bay region from 8,000-6,000 years ago, and the coast of Hudson and James Bays from about 7,000-3,000 years ago. Crustal uplifts ranging from 150-275 m have occurred since deglaciation. Eustatic rise of sea level exceeded the rate of uplift roughly 10,800 years ago, some time between 6,000-8,000 years ago, and about 5,000 years ago, resulting in local temporary regression and transgression of the sea. — *from* Author's abstract

05891 **Emilia, David Arthur.** Numerical methods in the direct interpretation of marine magnetic anomalies [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 2, p. 715B, 1969.

06048 **Emiliani, C.** Interglacial high sea levels and the control of Greenland ice by the precession of the equinoxes: Science, v. 166, no. 3912, p. 1503-1504, illus., table, 1969.

The relations between the generalized deep-sea core paleotemperature curve for the last 235,000 years, calibrated in terms of the Th-230/Pa-231 time scale, and the high sea levels shows that high sea levels follow closely perihelion coincidences, with an expected time delay of a few thousand years. This suggests that the second-order oscillations which cause the high sea levels are the result of significant melting of the Greenland icecap after interglacial conditions are established and when northern summer solstice occurs at perihelion. Total melting would raise present sea level about 10 m, and in this context Greenland appears more critical than Antarctica. Substantial melting of Greenland ice is expected in about 10,000 years. — DBV

06082 **Emiliani, C.; Rona, C.** Caribbean cores P6304-8 and P6304-9 — New analysis of absolute chronology — A reply [to discussion by W. S. Broecker and T. L. Ku of 1969 paper]: Science, v. 166, no. 3912, p. 1551-1552, illus., table, 1969.

Of four samples tested by Broecker and Ku (ibid., v. 166, no. 3903, p. 404-406, 1969), agreement between Miami and Lamont-Doherty results was found for two and disagreement for the other two; where disagreement exists, Broecker and Ku claim that their results were right. Emiliani and Rona believe exactly the opposite because (1) their results match exactly the C-14 time scale over the common range, and (2) their results are internally consistent; neither can be said for the results of Broecker and Ku. If the stretched time scale proposed by Broecker and Ku were adopted, the relationship between temperature and high sea levels would become random, with three of the seven high sea levels falling within glacial ages; in Emiliani

and Rona's time scale, high sea levels fall in every case within interglacial ages. [For original paper see ibid., v. 163, no. 3862, p. 62-68, 1969.]

England, C. B. *See* Stephenson, G. R. 06037

06117 **Enright, Richard.** The stratigraphy and clay mineralogy of the Eocene sediments of the northern New Jersey Coastal Plain, *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions—Geol. Soc. America, Ann.Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 14-20, illus., tables, 1969.

Recent detailed investigations of type localities and numerous subsurface samples indicate that a single lithology for these Eocene deposits is unwarranted. The Manasquam Formation, divided as originally described, consists of the newly named Farmingdale and Deal Members, the latter dominant in the subsurface; the redefined Shark River Formation includes a new subsurface unit, Toms River Member overlying Squankum Member. Planktonic foraminiferal biostratigraphy is reviewed, and subsurface facies relations are presented. Both the Farmington and Toms River clay mineral assemblages are similar to those from the Paleocene sediments of the New Jersey coastal plain. Clay minerals of the unique Deal Member indicate diagenesis of rhyolitic ash from as yet indeterminate volcanic sources, in significant amounts. — GDC

Erd, Richard C. *See* Morgan, Vincent. 05988

05886 **Erikson, Erik H., Jr.** Petrology of the composite Snoqualmie batholith, central Cascade Mountains, Washington: Geol. Soc. America Bull., v. 80, no. 11, p. 2213-2236, illus., tables, geol. map, 1969.

The Miocene epizonal Snoqualmie batholith consists of about 80 percent granodiorite, 12 percent quartz monzonite and alaskite, and 8 percent gabbro and diorite. These rocks are suggested to be a result of differentiation of andesitic magma that was modified by assimilation of cognate mafic rocks. Composition of feldspars in the silicic endmembers, alaskites, suggest crystallization at low pressures (1 to 2 kb). Stratigraphic setting suggests depths of emplacement between 4,000 and 8,000 feet. Rocks of the batholith are directionless, free of inclusions and in sharp contact with the wall rocks. — AH

Erlank, A. J. *See* Ahrens, L. H. 05869

Escowitz, Edward. *See* Lowrie, Allen. 06076

Esrig, M. I. *See* Sangrey, D. A. 05984

Etherington, J. R. *See* Jackson, D. E. 05790

Eugster, H. P. *See* Munoz, J. L. 05806

05690 **Faill, Rodger T.** Kink band structures in the Valley and Ridge province, central Pennsylvania: Geol. Soc. America Bull., v. 80, no. 12, p. 2539-2550, illus., 1969.

The folds of the Valley and Ridge province of central Pennsylvania, traditionally considered as open concentric folds continuous for long distances, are shown to be folds of limited length, and of planar limbs and narrow hinges that change in profile along trend. Structures as much as 50 feet wide, that transect bedding at large angles and show slickensides on bedding surfaces, are interpreted as large kink bands. If the kink band concept is applied to the fold structures, the fold geometry in both cross section and plan is more accurately represented. — *from* Author's abstract

05936 **Faill, Rodger Tanner.** The effect of loading rate in the experimental deformation of a limestone [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1752B-1753B, 1969.

06032 **Fairborn, J. W.** Shear wave velocities in the lower mantle: Seismol. Soc. America Bull., v. 59, no. 5, p. 1983-1999, illus., tables, 1969.

Traveltimes and $dT/d\Delta$ of earthquake-generated shear waves were measured, using the LASA in eastern Montana, to determine lower mantle shear velocities. Computer-generated velocity models which satisfied prescribed traveltime and $dT/d\Delta$-versus-Δ limits were considered as possible models for the real Earth. The $dT/d\Delta$ curve had anomalously steep slopes between 27°-30° and 65°-75°, and the corresponding velocity models had increased gradients between about 700-800 and 1,550 and 2,100 km. A decrease in slope at about 88° may indicate a decrease in velocity gradient several hundred kilometers above the core-mantle boundary. For epicentral distances greater than 27° the observed traveltimes were greater than the expected J-B times. A vague but systematic increase in observed residuals appeared to exist between 40° and 60° which agreed with J-B residuals of the computed models. — DBV

06287 **Fang, H. Y.** Influence of temperature and other climatic factors on the performance of soil-pavement systems, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 173-185, illus., 1969.

Typical climatic and environmental data obtained during the AASHO Road Test are summarized. Influence of temperature and climatic factors on performance of soil-pavement systems are examined, including effect of various cover conditions on: seasonal fluctuation of groundwater level, depth of frost penetration, and temperature in different parts of the soil-pavement system. The influence of temperature on soil-pavement performance as reflected in surface strains and deflections is discussed, and seasonal fluctuations of strength characteristics of pavement components and of subsurface conditions are evaluated. Data available from the AASHO Road Test can provide a useful basis on which to develop a more complete understanding of performance of soil-pavement system. — *from* Author's abstract

06371 **Ferrusquía V., Ismael.** Rancho Gaitan local fauna, early Chadronian, northeastern Chihuahua [with Spanish abs.]: Soc. Geol. Mexicana Bol. 1967, v. 30, no. 2, p. 99-138, illus., tables, 1969.

A small assemblage of vertebrates collected from the upper tuff member of an unnamed formation in northeastern Chihuahua is designated the Rancho Gaitan local fauna. It includes three genera of rodents, two of perissodactyls (?*Brontops* and ?*Hyracodon*), and five genera of artiodactyls (*Protoreodon, Agriochoerus, Bathygenys, Hypertragulus*, and cf. *Leptomeryx*), and a new species of *Hypertragulus* [heikeni]. The fauna, dated as early Chadronian, thus constitutes the first Oligocene fauna described from Mexico, and one of the southernmost early Tertiary mammalian faunas of North America. This fauna is correlated with the Little Egypt local fauna from the upper Chambers Tuff Formation of Rim Rock County, Tex. Moist environmental conditions prevailed in the area of the Rancho Gaitan local fauna. — *from* Author's abstract

Finn, P. J. *See* Holubec, I. 05982

05768 **Finney, J. J.** The unit cell of mooreite: Am. Mineralogist, v. 54, nos. 5-6, p. 973-975, illus., tables, 1969.

Mooreite, $(Mg,Zn,Mn)_5(SO_4)(OH)_{14} \cdot 4H_2O$, is monoclinic although the space group is not $P2_1/m$ as previously reported but rather $P2_1/a$. The new unit cell has $a = 11.18$, $b = 20.28$, $c = 8.23$ A and $\beta = 92°55'$ for which $Z = 4$. A new chemical analysis confirms the original formula except for one less H_2O molecule. — Author's abstract

05748 **Fisher, David E.** Evidence pertinent to the determination of meteoritic orbits from the observed frequency distribution of meteorite-Earth collisions and the observed meteoritic cosmic radiation age spectra [abs.]: Meteoritics, v. 4, no. 3, p. 170-171, 1969.

05814 **Fisher, George W.; Medaris, L. Gordon, Jr.** Cell dimensions and X-ray determinative curve for synthetic Mg-Fe olivines: Am. Mineralogist, v. 54, nos. 5-6, p. 741-753, illus., tables, 1969.

Twelve Mg-Fe olivine solid solution series were synthesized, six hydrothermally at 500 bars, and six at 2,000 bars, and were used to determine the variation of olivine unit-cell dimensions with mole fraction Mg_2SiO_4, and to calibrate an X-ray determinative curve based on the variation of $d(130)$ with composition. In both groups, b is a linear function of composition, but plots of a, c, V, density, and molar volume against mole fraction Mg_2SiO_4 are slightly curved and convex upwards, showing a small positive Δv of mixing. The best determinative curve for estimating x from measured values of $d(130)$(in A) is given. Plots of $d(130)$ and density against composition for the synthetic olivines agree closely with published data on natural Mg-olivines, however, natural iron-rich olivines have larger unit-cell dimensions. — *from* Authors' abstract

Fisher, William Lee. *See* Kaesler, Roger L. 05786

06142 **Flach, Klaus W.; Smith, Guy D.** The new system of soil classification as applied to arid-land soils, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 59-73, illus., tables, 1969.

Classes in the new comprehensive system of soil classification (7th Approximation) consist of soils of similar genesis that occur as natural units in the landscape. The definitions are in terms of morphological, chemical, and physical soil properties. Major soil-forming processes are reflected in *diagnostic surface* or *subsoil horizons* that are used repeatedly. The system has 10 orders at the highest and 8,000 series at the lowest level. Developed soils from arid lands are mostly in the order Aridisols. Aridisols with horizons of clay accumulation are in the suborder Argids; those without in the suborder Orthids. The presence or absence of pan horizons, sodium saturation, salinity, organic matter content, soil texture, mineralogy, and soil temperature are among the criteria for classes at lower categories. — *from* Authors' abstract

06310 **Fleischer, Michael.** Occurrences of $CaCO_3H_2O$ and its naming: Science, v. 166, no. 3910, p. 1309, 1969.

Marschner (ibid., v. 165, no. 3898, p. 1119-1121, 1969) reported the formation of $CaCO_3H_2O$ ("hydrocalcite") in scales deposited from cold waters and stated that it had not hitherto been observed in nature. However, the compound was first observed in bottom sediments from Lake Issyk-Kul in Kirgizia by Sapozhnikov and Tsvetkov (1959) and named "monohydrocalcite" by Semenov (1964). This name has priority over "hydrocalcite", and the latter is doubly unacceptable because it was used by Kosmoer in 1892 to designate a different hydrous calcium carbonate. The confusion could have been avoided had the proposed new name been referred to the Commission on New Minerals and Mineral Names of the International Mineralogical Association. — DBV

06347 **Fleischer, Michael.** How many minerals?: Am. Mineralogist, v. 54, nos. 5-6, p. 960-961, 1969.

Difficulties involved in answering this question are more evident if it is reworded: "How many of the existing 10,000 to 20,000 mineral names are considered to represent independent species?" The answer depends on the definition of independent species. One method, which does not work for all systems, is to call a mineral an independent species for each predominant cation in each structural position. Special committees on mineral groups of the IMA Commission on New Minerals and Mineral Names are working on these problems. The author's count gives 1,950 species as of January 1, 1969, and about 40 new species are added annually. — ESL

05749 **Fleischer, R. L.; Price, P. B.; Carter, R. W.** The Schenectady meteorite [abs.]: Meteoritics, v. 4, no. 3, p. 171, 1969.

Flinn, E. A. *See* Archambeau, C. B. 06273

Flower, R. H. *See* Yochelson, Ellis L. 05785

06088 **Flueckinger, Linda A.** Geology of a portion of the Allensville quadrangle, Centre and Huntingdon Counties, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 176, 1 sheet, scale 1:24,000, sections, text, 1969.

The portion of the Allensville quadrangle studied is in Barree and Jackson Townships. Strongly folded Late Ordovician to Middle Silurian formations of approximately 4,000 feet thickness consist almost entirely of unmetamorphosed detrital sedimentary rocks. Major landforms are five prominent, subparallel ridges separated by valleys. With one exception (synclinal ridge between Greenlee Mtn. and Bell Ridge), there is a direct relation between anticlinal and synclinal folds and resulting topographic forms. The formations have been deformed by concentric folding into a heirarchy of NE-SW trending, symmetrical and continuous structures. The least disturbed structures are two anticlines exposed discontinuously for 50-60 feet on the SW side of the gap cut by Laurel Run through the SE extension of Bell Ridge. Major faults are apparently absent; minor faults have been noted at four localities. — MCM

05815 **Forbes, Warren C.** Zircons of the White Mountain Magma Series — Belknap Mountain complex: Am. Mineralogist, v. 54, nos. 5-6, p. 787-795, illus., tables, 1969.

Zircon populations from several intrusive members of the White Mountain Magma Series were studied in terms of dimensions, elongation, complexity of single crystal morphology, color and variety of forms within a single population. In gabbro and diorite zircons are subhedral or anhedral. Euhedral crystals appear in the monzodiorite state and form an increasing larger percentage as the host rock becomes more silicic. Mean elongation of euhedral populations is constant throughout the series. Parameters such as color, single crystal morphology and elongation variance vary continuously with host rock composition. Population characteristics are most probably related to the length of the crystallization period of each population. — Author's abstract

Ford, D. C. *See* Brown, M. C. 06038

06084 **Foster, Helen L.; Keith, Terry E. C.** Geology along the Taylor Highway, Alaska: U.S. Geol. Survey Bull. 1281, 36 p., illus., table, geol. map, 1969.

The Taylor Highway extends 160 miles across the Yukon-Tanana Upland in eastern Alaska from Tetlin Junction on the Alaska Highway to Eagle on the Yukon River. It crosses a varied terrain underlain by a number of types of metamorphic, igneous, and sedimentary rocks; it also passes through the historic gold placer mining areas of the Fortymile country. Numerous well-developed physiographic features include sand dunes, stream terraces, entrenched meanders, and altiplanation surfaces. A road log describes and locates the geologic features along the highway. — Authors' abstract

Foster, Norman H. *See* Edmisten, Neil. 06205

06010 **Foster, Richard L.; Martin, Glen L.** Effect of unit weight and slope on erosion: Am. Soc. Civil Engineers Proc., v. 95, paper 6984, Jour. Irrigation and Drainage Div., no. IR4, p. 551-561, illus., tables, 1969.

Laboratory tests were performed on fine-grained soil slopes of 1:1, 2:1 and 3:1 using unit weights of 80, 85, 90 and 95 lb per cu ft and a simulated rainfall intensity of 6 in. per hr. After collecting runoff water and solid particles, the weight of solids eroded and the volume of runoff water were determined. Results and analysis of this study indicate that the slope and unit weight have definite effects on erosion of unprotected slopes. On the flattest slope, specimens compacted to the lowest unit weight experience the highest rate of erosion; on the steepest slope, specimens compacted to the highest unit weight experience the highest rate of erosion; and for a given unit weight, there is a unique slope from which the maximum amount of erosion will occur. — *from* ASCE abstract

Fowler, Michael L. *See* Anstey, Robert L. 06001

05750 **Fredriksson, Kurt.** A model for chondrite formation [abs.]: Meteoritics, v. 4, no. 3, p. 172-173, 1969.

05868 **Fredriksson, Kurt; Jarosewich, Eugene; Nelen, Joseph.** The Sharps chondrite — New evidence on the origin of chondrules and chondrites, Paper 14 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 155-165, illus., tables; discussion, p. 218, 1969.

Chemical, petrographic, and mineralogic studies of Sharps chondrite reveal a complex agglomerate of chondrules and lithic fragments in a matrix similar in composition to carbonaceous chondrites. One fragment type resembles Type II carbonaceous chondrites in composition but contains igneous glass depleted in sulfur and enriched in carbon. Carbon and sulfur contents and textures indicate heating after agglomeration, which indurated the whole rock but did not equilibrate major silicate phases. A few chondrules show two generations of olivine; evidence is given to show that preexisting chondritic, relatively iron-rich and nickel-poor olivine was caught in a second chondrule-forming process producing reduced silicates, iron-poor olivines, and glass which reacted with earlier olivine. Evidence favors the 'ignimbritic' model of chondrule and chondrite formation. — *from* Authors' abstract

06321 **Freeman, Tom; Schumacher, Dietmar.** Qualitative pre-Sylamore (Devonian-Mississippian) physiography delineated by onlapping conodont zones, northern Arkansas: Geol. Soc. America Bull., v. 80, no. 11, p. 2327-2334, illus., 1969.

Paleophysiography recorded by an unconformity is ordinarily delineated by either isopach-mapping the overlying rocks or by tracing the present-day configuration of the buried surface. A new approach to this problem has been developed through the plotting and contouring of biostratigraphic positions of scattered samples taken from the base of a transgressive unit. The resultant map shows the relative paleoelevations of the sample localities (the younger the sample, the higher its paleophysiographic position). In order to build this kind of map, the time of transgression must be biostratigraphically subdivisible; this requirement is met by the basal Sylamore Sandstone of Arkansas and Missouri (*Polygnathus varcus* through *Siphonodella isosticha-S. cooperi* conodont zones). — Authors' abstract

06040 **Freeze, R. Allan; Harlan, R. L.** Blueprint for a physically-based, digitally-simulated hydrologic response model: Jour. Hydrology, v. 9, no. 3, p. 237-258, illus., 1969.

In recent years hydrologists have subjected the various subsystems of the hydrologic cycle to intensive study, designed to discover the mechanisms of flow and to arrive at physical and mathematical descriptions of the flow processes. As a consequence, meaningful results are now available in the form of numerical solutions to mathematical boundary value problems for groundwater flow, unsaturated porous media flow, overland flow, and channel flow. These developments in physical hydrology, together with the tremendous advance in digital computer technology, should provide the impetus for a necessary redirection of research in hydrologic simulation. In this paper, a blueprint for the development of physically-based hydrologic response models is presented; the level of sophistication that can be achieved with presently available methodology is discussed; and areas for necessary future research are pinpointed. — Authors' abstract

05751 **French, Bevan M.** Distribution of shock-metamorphic features in the Sudbury basin, Ontario, Canada [abs.]: Meteoritics, v. 4, no. 3, p. 173-174, 1969.

05752 **French, Bevan M.; Miller, Ernest H.** Savonoski Crater, Alaska — A possible meteorite [abs.]: Meteoritics, v. 4, no. 3, p. 174-175, 1969.

05753 **Fricker, P. E.; Summers, A. L.; Goldstein, J. I.** Effects of fractionation on cooling rates in asteroidal bodies [abs.]: Meteoritics, v. 4, no. 3, p. 175-176, 1969.

Friedman, Irving. *See* Hitchon, Brian. 06042

06247 **Fritz, Peter.** The oxygen and carbon isotopic composition of carbonates from the Pine Point lead-zinc ore deposits: Econ. Geology, v. 64, no. 7, p. 733-742, illus., 1969.

The oxygen isotopic composition of the mineralizing fluids, estimated from 0 ratios for dolomite and inferred fractionation factor, suggests that the fluids were of stratafugic origin and comparable to formation water. Late calcite was deposited by water made isotopically lighter by influx of surface water. Most of the hydrothermal carbonates contain carbon dissolved from and isotopically similar to that of the marine carbonates. In the latest calcites, a decrease in temperature led to an enrichment in heavy carbon paralleling the decrease in heavy oxygen. — WSW

05902 **Fritze, K.; Robertson, R.** Precision in the neutron activation analysis for gold in standard rocks G-1 and W-1, *in* Modern trends in activation analysis, V. 2 — Internat. Conf., Gaithersburg, Md., 1968, Proc.: U.S. Natl. Bur. Standards Spec. Pub. 312, v. 2, p. 1279-1283, tables, 1969.

An investigation of the distribution of gold in standard samples G-1 and W-1 was undertaken to explain discrepancies observed in previous activation analyses of these samples. For the new analysis, neutron irradiation was followed by recording of gamma spectra using a 12 cm^3 coaxial Ge(Li) detector and a Series 200 Nuclear Data 1024 channel analyzer; some samples were also measured with a 7.5 × 7.5 cm NaI(Tl) crystal and a Nuclear Data 256 channel analyzer. Tabulated results clearly indicate that the trace quantities of gold in G-1 and W-1 are not homogeneously distributed in the two rock samples; this effect is much stronger in G-1 which explains the better results obtained in the past for W-1. A larger number of analyses are required for interpretation of the distribution; work is now in progress. — VSN

05701 **Frost, Michael J.** Size and spacial distribution in meteorite showers: Meteoritics, v. 4, no. 3, p. 217-232, illus., 1969.

Size distribution in the Barwell, Bruderheim, Gibeon, Johnstown, Sikhote-Alin and Tenham showers is studied. On the assumption that the distribution follows the Gates-Gaudin-Schumann law, which describes artifically crushed material, it is estimated that 80 percent of the fine material of the Gibeon shower was not collected; for the other showers the figure varies between 52 and 61 percent. Spatial distribution patterns of the Barwell, Johnstown, Krymka, Kunashak, Leedey, Plainview (1917), and Sikhote-Alin meteoritic showers show considerable regularity and indicate that the distribution pattern of fragments of any one size is a function of the sorting factor, which is the distance in kilometers between groups of fragments whose mass differs by an order of magnitude. — *from* Author's abstract

06311 **Fry, Gary F.; Moore, John G.** *Enterobius vermicularis* — 10,000-year-old human infection: Science, v. 166, no. 3913, p. 1620, illus., 1969.

Eggs of *Enterobius vermicularis* (human pinworm) were found in human coprolites from Hogup and Danger Caves, western Utah. The caves were inhabited by man from 10,000 B.C. to A.D. 1400. The oldest coprolite containing *E. vermicularis* was radiocarbon dated at 7837 B.C. This represents the earliest known association between man and this exclusively human parasite. — Authors' abstract

05754 **Fuchs, Louis H.** X-ray crystallographic evidence for the meteoritic occurrence of nepheline [abs.]: Meteoritics, v. 4, no. 3, p. 176-177, 1969.

05838 **Fuchs, Louis H.** The phosphate mineralogy of meteorites, Paper 56 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 683-695, illus., tables; discussion, p. 716, 1969.

Nine phosphate minerals are found in meteorites: whitlockite, chlorapatite, hydroxyapatite, sarcopside, graftonite, farringtonite, stanfieldite, brianite, and panethite. The last four are found only in meteorites. Ordinary chondrites contain whitlockite and chlorapatite but no other phosphates; other phosphates are found in more dif-

ferentiated classes of meteorites. Whitlockite is the predominant phosphate mineral in meteorites. Small variations in composition can be correlated with other compositional features that vary from one class of meteorites to another. Chlorapatite is found in meteorites to the exclusion of fluorapatite, which is the common apatite in igneous rocks. If phosphate minerals are in equilibrium with associated schreibersite, a relative degree of oxidation can be calculated for meteorites containing a particular phosphite-phosphate pair. — *from* Author's abstract

05675 **Fuller, John G. C. M.** The industrial basis of stratigraphy — John Strachey, 1671-1743, and William Smith, 1769-1839: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2256-2273, illus., 1969.

Coal-fueled atmospheric engines met the need for new sources of mechanical power in 18th Century England and propelled the country into an industrial revolution. Coal exploitation prompted attendant mineral surveying, land drainage, and better transportation routes. John Strachey illustrated stratigraphic succession, bedding attitude, faulting, and unconformity in the Somersetshire coal field. William Smith recognized natural order and regularity in strata and their organic contents during his surveys and drainage work. Thus, their imaginative application of traditional colliers' lore was brought to contemporary scientific attention and put to work in a wider field. — EGS

06249 **Gabrielse, H.** Geology of Jennings River map-area, British Columbia (104-0): Canada Geol. Survey Paper 68-55, 37 p., illus., geol. map, 1969.

The Jennings River map-area is mainly within Cassier Mts. and Stikine Plateau. In the northeastern part stratified rocks range in age from Proterozoic to possibly Permian. Pre-Mississippian rocks are nonvolcanic, younger rocks include abundant volcanics. Southwest of Cassiar batholith the area is underlain by Carboniferous and Permian cherts, slates, quartzites, limestones, and volcanics in part regionally metamorphosed, and locally overlain unconformably by Triassic volcanics and minor sedimentary rocks and by Lower Jurassic, greywacke and slate. Large bodies of granitic rocks (Jurassic, to Early Tertiary) have intruded the stratified rocks; late Tertiary, Pleistocene, and Recent volcanic centers have produced volcanoes and gently-dipping flows. Regional deformation occurred during Triassic time; later deformations involved Triassic and Jurassic? strata. —*from* Author's abstract

06345 **Gaines, Richard V.** Cliffordite — A new tellurite mineral from Moctezuma, Sonora, Mexico: Am. Mineralogist, v. 54, nos. 5-6, p. 697-701, tables, 1969.

Cliffordite, named in recognition of the many contributions of Clifford Frondel to the mineralogy of uranium, occurs along joint surfaces in the oxidized zone of the San Miguel mine. The small octahedrons are bright yellow with adamantine luster. The mineral is isotropic and the index of refraction higher than 2.11. Insufficient material was available for quantitative analysis or specific gravity determination, but X-ray fluorescence analysis showed only uranium and tellurium from the San Miguel mine. Synthetic material was identical in color, habit, and powder pattern with the natural. Single crystal precession photos showed $a = 11.371$ A and space group $Pa3$, $Z = 8$. Cliffordite from the Moctezuma mine contains a little lead and is identical with the lead oxyfluoride described by Mandarino and Williams in 1961. The lead oxyfluoride is therefore not a valid species. — *from* Author's abstract

05977 **Galegar, William C.; DeGeer, Myron W.** Measuring subsurface spring flow with radiotracers: Am. Soc. Civil Engineers Proc., v. 95, paper 6973, Jour. Sanitary Eng. Div., no. SA6, p. 1097-1103, illus., 1969.

A hydrostatic head was imposed on Estelline Spring [Texas] to prevent surface discharge and subsequent natural salt pollution of Red River. This paper describes the use of tritiated water as a tracer to determine the rate of subsurface leakage of the spring, size of the spring cavern, and location of that area where subsurface leakage returns to the surface. Other techniques using salt and organic dyes did not prove successful. The volume of the known spring chimney, including that within the dike, amounts to about 389,800 cu feet. Knowing the amount of tracer added and the ini-

tial concentration of tracer after mixing, it was determined that a volume of 493,960 cu feet existed. From these data, it is concluded that a second chamber exists below that which was previously known; its volume amounts to about 104,000 cu feet. — *from* ASCE abstract

06131 **Ganapathy, R.; Anders, Edward.** Ages of calcium-rich achondrites — [Pt.] 2, Howardites, nakhlites, and the Angra dos Reis angrite: Geochim. et Cosmochim. Acta, v. 33, no. 7, p. 775-787, illus., 1969.

He, Ar and Ne gases were measured in 11 howardites, 2 nakhlites and 1 angrite. The age distribution for howardites resembles that of eucrites with clusters appearing at 11, 19, and 29 m.y. The two nakhlites have almost identical ages but are probably independent falls. Howardites and nakhlites, like eucrites, tend to have U-He ages that are shorter than K-Ar ages. A U-He age as high as 5.1 AE was obtained for the angrite Angra dos Reis. — KAF

Gardner, P. M. *See* Anderson, P. C. 06176

05799 **Gartner, Stefan, Jr.; Bukry, David.** Tertiary holococcoliths: Jour. Paleontology, v. 43, no. 5, p. 1213-1221, illus., 1969.

Holococcoliths, coccoliths constructed of minute calcite crystallites of uniform size, have been recorded chiefly in association with living coccolithophores, and only two species have hitherto been reported from the fossil record. Electron microscopic study has shown the following fossil species to be holococcoliths: *Clathrolithus spinosus, Discolithina? macropora, Orthazygus aureus, Lanternithus minutus, Peritrachelina joidesa, Zygrhablithus bijugatus,* and *Daktylethra punctulata,* n.gen., n.sp. All of the above species occur in the interval from the middle Eocene to the lower Oligocene, and several have wide geographic distribution. [Samples used in this study are from New England continental slope, Alabama, Mississippi, and Denmark.] — *from* Authors' abstract

06236 **Garvin, R. F.** Bridger Lake Field, Summit County, Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range—Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 109-115, illus., tables, 1969.

Bridger Lake Field, located on the Church Buttes-Moxa Arch trend, produces from Cretaceous Dakota Sandstone. Since its discovery in early 1966 the field has grown to eight wells that have produced more than 2,710,000 barrels of oil. The Fork A-10 Unit was drilled to 17,910 feet in the Triassic Nugget Sandstone and marks the deepest penetration in the field. More wells are to be drilled in the future and a miscible gas injection secondary recovery program is in the initial stages of preparation. — *from* Author's abstract

05937 **Gassaway, John Duncan.** The mineralogy and geochemistry of the sediments of the Straits of Florida [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1753B, 1969.

Gatrall, M. *See* Whitaker, J. H. McD. 05997

Gault, D. *See* Greeley, R. 05710

05755 **Gault, Donald E.** On cosmic-ray exposure ages of stone meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 177, 1969.

Geiss, J. *See* Bochsler, P. 06337

Gelpi, E. *See* Oró, J. 05858

06114 **Geological Society of America; Subitzky, Seymour.** (editor). Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — GSA and associated societies, Ann. Mtg., Atlantic City, N. J., 1969: New Brunswick, N. J., Rutgers Univ. Press, 382 p., illus., tables, 1969.

This volume, designed to provide background material and guides to six field trips, contains 16 (separately cited) reports on latest concepts of geoscientific knowledge pertaining to the middle Appalachian region and areas adjacent to the Delaware Valley in New Jersey and Pennsylvania. Within selected topical reports of reference value, the following are described: the geology of Precambrian and folded Paleozoic rocks of the middle Appalachian region and Triassic rocks of the Newark basin; paleoenvironment of the Cretaceous-Tertiary deposits of the New Jersey Coastal Plain; that state's Quaternary deposits, glacial, fluviatile and marine; engineering and hydrogeologic problems of Tocks Island and Yards Creek; and geology of ilmenite deposits in the New Jersey Coastal Plain, with summary of exploration leading to the delineation of four ore bodies. — *from* Foreword

06014 **Giacconi, Riccardo; Harris, Bernard.** Comments on remote sensing, *in* Internat. Geosci. Electronics Symposium, 1st Ann. (Selected papers): IEEE Trans. Geosci. Electronics, v. GE-7, no. 4, p. 179-190, illus., 1969.

A logical step-by-step treatment of a remote sensing problem begins with a definition of the question which is subsequently followed by the physical requirements necessary to obtain the answer. Some limitations are imposed by environmental factors in addition to state-of-the-art instrumentation. Although many broad types of remote sensing techniques exist, use of the electromagnetic spectrum appears to be most promising and rewarding. Each band of the spectrum holds its own key to unlocking a particular answer required to define the state of the object under study. In each band several parameters are on hand, such as intensity, polarization, spatial and wavelength resolution. The single most severe limitation appears to be data handling and synthesis. The problem can be greatly alleviated if a proper model is available to treat data by a systematic method. — *from* Authors' abstract

Gibbs, G. V. *See* White, E. W. 05808

05756 **Gigl, Paul D.; Dachille, Frank.** Meteorite sonic booms [abs.]: Meteoritics, v. 4, no. 3, p. 177-178, 1969.

Gillam, W. Sherman. *See* Collins, A. Gene. 06080

05889 **Gilluly, James.** Geological perspective and the completeness of the geologic record: Geol. Soc. America Bull., v. 80, no. 11, p. 2303-2311, illus., tables, 1969.

This note attacks the dogma that all of geologic history is susceptible to equally fine discrimination regardless of age by comparing on the geologic maps of North and South America the size areas of exposure of rocks of several time and process bracketed categories. The results presented in tables and graphs, although crude, show a systematic loss of the record as is to be anticipated when factors of burial and cannibalizing are considered. — RGY

06052 **Gilluly, James.** Oceanic sediment volumes and continental drift: Science, v. 166, no. 3908, p. 992-994, 1969.

The volume of sediment off the Atlantic Coast of the United States is at least six times as great as that off the Pacific Coast. This disparity is readily accounted for if the continent is drifting westward and has overrun large volumes of sediment on a former Benioff zone. Such an overrunning is also consonant with many features of the geology of the western United States. — Author's abstract

06363 **Gilmour, E. H.** Carbonate petrology of the Alaska Bench Formation, central Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 179-200, illus., 1969.

Carbonate facies identified in the Alaska Bench Formation are: algal biolithic (intertidal to supratidal); ostracod mud facies (supratidal, intertidal, bays, lagoons); mud facies (bays, lagoons, normal marine); gastropod-sparry blade-ostracod mud facies (intertidal, nearshore marine); sparry blade mud facies (nearshore marine); rounded algal biosparite (high energy shoals or banks); oolite facies (high energy shoals or banks); churned facies (normal marine); and silty mud facies (terrestrial, supratidal-

intratidal, normal marine). A fossiliferous and an unfossiliferous dolomite were determined but do not serve as depositional indicators except for possible primary dolomite. These facies were deposited as cyclic units and record the transgressive-regressive movements of the strand line of the Morrowan sea across central Montana. — *from* Author's conclusions

Giraud, R. *See* Cayé, R. 05836

05774 **Giudice, D. del; Recchi G.** Mapa geológico del área del Proyecto Minero de Azuero: Panamá Admin. Recursos Minerales Mapa 5 (GL-4), 2 sheets, scale 1:250,000, 1969.

06166 **Glanville, C. Richard.** Large-scale log interpretations of water saturation for two complex Devonian reef reservoirs in western Canada: Log Analyst, v. 10, no. 5, p. 12-19, illus., tables, 1969.

A large-scale study of more than 125 wells has provided excellent fluid saturation data for two complex Devonian reef reservoirs in western Canada. These data, presented as plots of elevation vs. water saturation profiles for specified ranges of porosity, show fluid saturations to vary with elevation to a height more than 225 feet above the field-established oil/water contacts. Quantitative interpretations were made possible by an excellent combination of logs, special techniques for reading and correcting the logging curves, and special core analyses. Induction logs were found applicable to low-conductivity, oil-bearing beds by using dense beds to correct for the conductivity zero errors and borehole signals. Calculations were obtained through a special digital computer program using an IBM 7044 computer; a Cal Comp plotter provided the water saturation profiles for eight different ranges of porosity. — Author's abstract

Goldman, Bram J. *See* McGinnics, William G. 06359

Goldstein, J. I. *See* Fricker, P. E. 05753

05831 **Goldstein, J. I.** The classification of iron meteorites, Paper 59 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 721-737, illus., tables; discussion, p. 838-839, 1969.

A genetic classification system has been developed to group iron meteorites which form in the same parent body. The system uses comparison of the cooling rate of the parent body during formation of the Widmanstätten pattern and the Ga-Ge trace-element content. Cooling rate groups are defined by measurements of both band width and Ni content in more than 250 irons. The commonly used structural classification system is refined also by addition of a large amount of band-width data. Data used in the study are tabulated in an appendix. The observed correlation between cooling rate groups and Ga-Ge groups indicates that meteorites common to both groups come from the same parent. — VSN

Goldstein, J. I. *See* Doan, A. S., Jr. 05834

Goldstein, Joseph I. *See* Buseck, Peter R. 06320

Goles, Gordon G. *See* Piper, David Z. 05971

05954 **Goodwin, Michael Lawrence.** Love and Rayleigh wave phase velocities over United States continental paths [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1763B, 1969.

05707 **Gopalan, K.; Kaushal, S. K.; Wetherill, G. W.** Rb^{87}-Sr^{87} isochron for amphoterite (LL) and bronzite (H) chondrites [abs.]: Meteoritics, v. 4, no. 3, p. 179, 1969.

Gordon, G. M. *See* Larson, R. E. 06278

05938 **Gornitz, Vivien Monisa.** Mineralization, alteration and mechanism of emplacement, Orphan ore deposit, Grand Canyon, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1753B, 1969.

06232 **Gosar, A. J.; Hopkins, J. C.** Structure and stratigraphy of the southwest portion of the Rock Springs uplift, Sweetwater County, Wyoming, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range—Intermtn.Assoc.Geologists (and Utah Geol.Soc.), 16th Ann.Field Conf.1969: Salt Lake City, Utah, Utah Geol. Survey, p. 87-90, illus., geol. map, 1969.

The formations described are: the Cretaceous Baxter and Lewis Shales, and the Blair, Rock Springs, Ericson, Almond, and Lance Formations; the Paleocene Fort Union Formation; and the Eocene Wasatch and Green River Formations. The Rock Springs uplift is a product of the Laramide orogeny. Faulting, both transverse and parallel with the main north-south trends, resulted in deposition of the Paleocene Fort Union Formation, pre-Fort Union erosion having removed much of the section. Eocene rocks were deformed by the Uinta uplift to the south and the intersection of the north-south trends and the Uinta trends resulted in the structural complexity of the region. — HRC

05791 **Gould, Stephen Jay.** The byssus of trigonian clams — Phylogenetic vestige or functional organ?; Jour. Paleontology, v. 43, no. 5, p. 1125-1129, illus., 1969.

Neotrigonia is a very active, free-living bivalve, yet its adult foot contains a rather extensive, though nonfunctional, byssal apparatus. Is this apparatus a phylogenetic residue, reduced from its form in a byssate adult ancestor, or does it function at an earlier stage of trigonian ontogeny? There is no firm evidence for the existence of a byssus in Mesozoic adult trigonians. Gould favors the hypothesis that the trigonian byssus is functional in juveniles for two reasons: Most, and perhaps all, bivalves are byssally attached in the post-larva and several prolong this habit into later juvenile stages. In the single juvenile specimen examined, the byssal organs were better developed than in adults. — *from* Author's abstract

Gradsztajn, E. *See* Bernas, R. 05866

06281 **Graham, Earl K.; Barach, G. R.** Elastic constants of single-crystal forsterite as a function of temperature and pressure: Jour. Geophys. Research, v. 74, no. 25, p. 5949-5960, illus., tables, 1969.

The pressure dependence of the nine adiabatic stiffness constants of single-crystal forsterite is found to be linear up to 10 kb. In the temperature range 300°-700°K, the temperature dependence is linear above 500°K but somewhat curved below that. The nine adiabatic stiffnesses and their isothermal pressure derivatives at 28°C are presented, and the isobaric temperature derivatives are given at zero pressure at temperatures above 500°K. The results suggest that the elastic properties of forsterite are predominantly determined by the oxygen anion framework. The results are used to calculate the isothermal pressure dependence and volume of the first lattice parameters at high pressure from the Murnaghan and Birch equations of state. — DBV

05709 **Grant, Raymond.** The occurrence of silica minerals in meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 180-181, table, 1969.

05710 **Greeley, R.; Gault, D.; Bunch, T.** The Swan Valley "craters" (Idaho) [abs.]: Meteoritics, v. 4, no. 3, p. 182, 1969.

Green, Morton. *See* Parris, David C. 05805

05711 **Greenwood, William R.; Morrison, Donald A.** Genetic significance of the morphology of some impact bombs from Meteor Crater, Arizona [abs.]: Meteoritics, v. 4, no. 3, p. 182-183, 1969.

06181 **Greer, Raymond T.** Submicron structure of "amorphous" opal: Nature, v. 224, no. 5225, p. 1199-1200, illus., 1969.

Scanning electron microscopy has been used to identify face-centered cubic arrays of submicron spherical particles as comprising the amorphous (to X-rays) precious variety of opal and as causing iridescence in accordance with diffraction theory. — DBV

Greggs, Robert G. *See* Bartlett, Grant A. 06063

05990 **Gretener, P. E.** Fluid pressure in porous media, its importance in geology — A review: Bull. Canadian Petroleum Geology, v. 17, no. 3, p. 255-295, illus., tables, 1969.

An attempt is made to summarize the importance of the pore-fluid pressure in porous rocks. Normal versus abnormal fluid pressures are discussed. The causes of abnormal fluid pressures are described and the theoretical upper limit of such pressures is reviewed. The significance of the pore-fluid pressure in terms of physical parameters such as the sonic velocity, the electrical resistivity and the mechanical behaviour is reviewed. Also discussed is the effect of the pore-fluid pressure on such phenomena as landslides, overthrusts, formation of open joints, sedimentary structures, and pressure solution. — Author's abstract

05991 **Gretener, P. E.; Labute, G. J.** Compaction — A discussion: Bull. Canadian Petroleum Geology, v. 17, no. 3, p. 296-303, illus., 1969.

A brief discussion is presented of the factors that influence the compaction a formation has undergone. It is shown that these factors are: lithology, initial thickness, maximum effective pressure, and the rate at which pressure is applied. — Authors' abstract

Gretener, P. E. *See* Labute, G. J. 05992

06275 **Grey, Donald C.** Geophysical mechanisms for C-14 variations: Jour. Geophys. Research, v. 74, no. 26, p. 6333-6340, illus., 1969.

Simple models are employed to discuss the effects of the modulation of the cosmic-ray flux in the Earth's atmosphere by the solar wind and by geomagnetic field variations on the variations of C-14 in the atmosphere. It is shown that a good predictive model of short-term variations in atmospheric C-14 can be based on sunspot numbers, whereas long-term variations appear to correlate well with paleomagnetic variations. — Author's abstract

06044 **Griffin, W. L.; Murthy, V. Rama.** Distribution of K, Rb, Sr, and Ba in some minerals relevant to basalt genesis: Geochim. et Cosmochim. Acta, v. 33, no. 11, p. 1389-1414, illus., tables, 1969.

The abundance levels of K, Rb, Sr, and Ba in pyroxenes, olivines, and garnets of ultramafic rocks are too low to yield a satisfactory composition for an upper mantle composed of these phases. This deficiency can be corrected by incorporation of a combination of plagioclase, hornblende, and phlogopite. Concentrations of these elements in the above minerals have been used to calculate the abundances in various model mantles. It is found that the presence of 2-5 percent hornblende and trace amounts of phlogopite in the upper mantle are necessary for the generation of oceanic tholeiitic and alkali basalts; alkali basalts can be derived through 5-10 percent partial melting of this mantle, and oceanic tholeiites by 20-30 percent melting. — DBV

06165 **Griggs, D. T.; Baker, D. W.** The origin of deep-focus earthquakes, *in* Properties of matter under unusual conditions (in honor of Edward Teller's 60th birthday) (Hans Mark and Sidney Fernbach, editors): New York and London, Interscience Publishers, p. 23-42, illus., 1969.

It seems unlikely that deep-focus earthquakes can be caused by any of the known types of rupture, yet the seismic waves have the characteristics of a shear-fracture source. It has been shown that this type of behavior can be produced by shear-melting instability due to thermally activated flow in materials subject to shear strain at

high pressure and temperatures. It is believed that this process was the cause of the "snapping" observed in Bridgman's high pressure shearing experiments. In this case, the hypothesis can be quantitatively checked by appropriate experiments. Application to deep-focus earthquakes is fraught with more uncertainty, but the fact that this process can qualitatively produce the effects of these seismic events warrants more thorough study of this phenomenon. — Authors' conclusion

05916 **Griggs, Gary Bruce.** Cascadia Channel — The anatomy of a deep-sea channel [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1816B-1817B, 1969.

06198 **Groff, S. L.** Solid fuel energy, the future of eastern Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 213-217, 1969.

Development of solid fuel resources in eastern Montana is related directly to technological progress; the major resource available is coal. The laying of the groundwork has been underway since 1964 (for its development) and development and production should come rapidly. Uranium in eastern Montana has received little consideration in this paper. If gamma-ray logging through the Fort Union Formation had been common practice for many years, it is possible that relatively large deposits of uranium mineable by solution would now be delineated. Surface indications have not yet been good. — *from* Author's conclusions

Grögler, N. *See* Bochsler, P. 06337

Grögler, Norbert. *See* ElGoresy, Ahmed. 05708

06065 **Guber, Albert L.** Sedimentary phosphate method for estimating paleosalinities — A paleontological assumption: Science, v. 166, no. 3906, p. 744-746, illus., 1969.

Paleosalinity values in certain rocks determined by the sedimentary phosphate method differ from salinity estimates based upon contained fossil assemblages, geochemical methods, and existing stratigraphic controls. Some anomalous values are related to the abundance of fossil organisms known to be concentrators of calcium phosphate. Because of the abundance and diversity of organisms which might introduce significant errors into paleosalinity estimates, the sedimentary phosphate method seemingly is of limited applicability. — Author's abstract

Gude, Arthur J., 3d. *See* Sheppard, Richard A. 05812

05843 **Guskova, E. G.; Pochtarev, V. I.** Magnitnyye svoystva meteoritov kollektsiy sovetskogo soyuza [with English abs.], Paper 52 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 633-637, illus., tables; discussion, p. 714, 1969.

Results are reported of an investigation of the magnetic properties of more than 900 specimens of stone, stony iron, and iron meteorites in eight collections of meteorites in the U.S.S.R. It was found that the magnetization of meteorites is not affected by the fusion crust or by impact with the Earth in presence of the Earth's field, and that the natural remanent magnetization is of extraterrestrial origin. It was concluded that the magnetization is of thermoremanent character and, since it presupposes heating of meteoritic matter to 800°C, it must have been acquired in the parent body. — VSN

Guymon, Gary L. *See* Longenbaugh, Robert A. 06011

Hade, George. *See* Molnar, Peter. 06182

Haffty, Joseph. *See* Rye, Robert O. 05901

06238 **Hager, Dorsey.** Unorthodox methods of finding oil, minerals and water, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc.

Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 53-55, 1969.

This is a summary of various unorthodox methods that have been used to prospect for minerals; several personal case-histories are cited also. The various techniques have been classified as follows: (1) some geologic basis (graveyards, creekology, trends); (2) sensory (tactile, gustatory, olfactory, auditory, visual); (3) subconscious or unconscious (visions, dreams, strong incentive, hunches, gamblers, spiritualism, medicines, spirit guides); (4) subconscious ideomatic (divining rods, revolving metal rods, rods with secret chemicals, bobbing devices, pendular devices); (5) pseudoscientific devices (mysterious boxes, gravity, magnetic, radiometric, electric, seismic, photographic). We are reminded that many of these devices were successfully tried on well-educated persons without any geologic background. — HRC

06235 **Hale, Lyle A.** Northern Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 101-108, revised 1969; originally published 1963.

This brief description of the major structures and stratigraphy of northern Utah includes the Uinta Mountain anticline, the Wasatch Range, the Idaho-Wyoming overthrust belt, and the Green River basin. Emphasis is placed upon the Coalville anticline, at the western edge of the Uinta Mountains, because of its well-known economic potential. — HRC

Halstead, E. C. *See* Souther, J. G. 06360

05939 **Ham, William Eugene.** Geology and petrology of the Arbuckle Limestone in the southern Arbuckle Mountains, Oklahoma [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1754B, 1969.

06147 **Hamelin, Louis-Edmond; Cailleux, André.** Les palses dans le bassin de la Grande-Rivière de la Baleine [with English and Russian abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 329-337, illus., 1969.

The studied swarm is 300 m in diameter and is made of 30 oval or elongated peat hummocks, 5 to 7 m high, 15 to 40 m long, and 13 to 16 m broad, separated by depressions. On August 10 frozen peat was found at about 50 cm depth. These palsen peal off on the sides, giving big pieces and fragments that leave the peat bare. At their foot, the pieces of peat disintegrate and are spread around. Palsen are partly or wholly surrounded by a watery ditch, probably resulting from melting of ground-ice near the warmer water in summer; they are at present disintegrating rather than growing. The area was drowned just after the last glacier retreat, and then rebounded to its present elevation; it was emersed after the hypsithermal period, and then the peat could form and afterwards bulge into palsen. — *from* Authors' abstract

06059 **Hamilton, R. M.; McKeown, F. A.; Healy, J. H.** Seismic activity and faulting associated with a large underground nuclear explosion: Science, v. 166, no. 3905, p. 601-604, illus., 1969.

The 1.1-megaton nuclear test Benham caused movement on previously mapped faults and was followed by a sequence of small earthquakes. These effects were confined to a zone extending not more than 13 kilometers from ground zero; they are apparently related to the release of natural tectonic strain. — Authors' abstract

06189 **Hamilton, R. M.; Yerkes, R. F.; Brown, R. D., Jr.; Burford, R. O.; DeNoyer, J. M.** Seismicity and associated effects, Santa Barbara region, Chap. D *in* Geology, petroleum development, and seismicity of the Santa Barbara Channel region, California: U.S. Geol. Survey Prof. Paper 679, p. 47-68, illus., tables, 1969.

The seismically active Santa Barbara Channel region has experienced two earthquakes of magnitude 6 since 1900, and in 1812 was the site of a shock of probable magnitude 7. Earthquakes of magnitude 6 and larger can be expected to occur in

the future, possibly several in the next century. It is not known which of the several channel faults are seismically active because of lack of network data. A large earthquake would cause intense shaking with associated ground deformation and failure, particularly in artificially-filled areas, alluviated valleys, and unstable hillside slopes. Resulting damage to manmade structures would be great, especially during the wet season. Oil installations would probably also suffer damage, but effects can be reduced by certain standard practice precautions; hazards are tabulated. — *from* Authors' summary

05696 **Hamilton, Warren.** Mesozoic California and the underflow of Pacific mantle: Geol. Soc. America Bull., v. 80, no. 12, p. 2409-2429, illus., 1969.

The Mesozoic evolution of California is interpreted as dominated by underflow of oceanic mantle beneath the continental margin. As open-ocean abyssal oozes, island arc volcanics, and the oceanic crust beneath them were swept into the Benioff-zone trench at the continental margin, they were covered by terrigenous clastic sediments, and the entire complex (Franciscan Formation) was carried beneath the correlative continental-shelf and continental-slope deposits (Great Valley sequence) and the older Mesozoic complexes. The other eugeosynclinal terranes of California can be interpreted in similar terms of underflow of Pacific Mantle. Palinspastic reconstruction reveals a Cretaceous tectonic pattern strikingly like the modern pattern of the South American Andes. — HCW

05940 **Hamilton, Wayne Lee.** Microparticle deposition on polar ice sheets [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1754B, 1969.

06104 **Hamza, V. M.; Verma, R. K.** The relationship of heat flow with age of basement rocks: Bull. Volcanol., v. 33, no. 1, p. 123-152, illus., table, 1969.

The relationship of heat flow to age of the basement rocks has been studied for USA and Canada, Australia and India. In areas of sedimentary basins the ages of the cores obtained from the metamorphic or igneous basement were used for such correlation. It is found that heat flow values for all continents studied show a definite correlation with age, the relatively high heat flow being associated with younger basements. Such correlation when fully established will enable us to correlate heat flow values with geology and ages of tectonic events which have occurred in the Earth's crust. — Authors' abstract

06130 **Hanor, Jeffrey S.** Barite saturation in sea water: Geochim. et Cosmochim. Acta, v. 33, no. 7, p. 894-898, tables, 1969.

Thermodynamic calculations suggest that the total aqueous complexing of barium and sulfate and the presence of strontium in both aqueous and solid solution have a significant effect on the saturation relations of barite in sea water. Ocean waters in which pure $BaSO_4$ appears to dissolve may actually be saturated with respect to $(Ba, Sr)SO_4$ of intermediate composition. — Author's abstract

06233 **Hansen, Wallace R.** Quaternary faulting at Towanta Flat, on the south flank of the Uinta Mountains, Duchesne County, Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 91-92, illus., 1969.

Well-defined fault scarps are described from the vicinity of Mountain Home. The faults cut across two levels of glacial outwash downstream from the terminal moraine of the former Lake Fort glacier; the moraines and terraces are of Bull Lake age. Nearby Pinedale-aged terraces are not faulted. The faulting is therefore between 11,000 and 32,000 years old. The set trending N. 55-50° E. is the strongest, the set trending N. 70 to 90° W. is weaker, and a subordinate set trends N. 70° E. The maximum vertical displacement is about 40 feet. — HRC

06234 **Hansen, Wallace R.** Development of the Green River drainage system across the Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick

range - Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 93-100, illus., 1969.

The original drainage north of the Uinta range was toward the east, and that south of the range toward the south. During the Tertiary, the Browns Park graben was formed and filled with material from the eastward-flowing streams which were being backed up and ponded by the rising continental divide area. The entire eastern end of the range was blanketed by fill. The stagnating drainage finally spilled over the Uinta crest and was diverted to the south drainage. The new gradient resulted in headward erosion and the main Green River was finally captured and turned south. — HRC

Hanson, Larry G. *See* Whetten, John T. 06244

06243 **Harding, Samuel T.; Algermissen, S. T.** The focal mechanism of the Prince William Sound earthquake of March 28, 1964, and related earthquakes, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 185-221, illus., tables, 1969.

The type 1 mechanism solution for the March 28, 1964, Alaska earthquake indicates predominantly dip-slip faulting on a steeply dipping plane. The preferred solution is a type 2 mechanism with the following P nodal planes: strike N. 62° E., dip 86° S. (*a* plane); strike N. 22° W., dip 52° W. (*b* plane). Two solutions are possible: right lateral faulting which strikes northeast, or left lateral faulting which strikes northwest. Both possible fault planes dip steeply. Left lateral faulting is suggested by the mechanism solutions of the majority of aftershocks. — KAF

Harding, Samuel T. *See* Sherburne, R. W. 06266

Harlan, R. L. *See* Freeze, R. Allan. 06040

05676 **Harlton, Bruce H.** Relation of fault systems to oil accumulation on eastern margin of Arbuckle Mountains, southeastern Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2290-2298, illus., 1969.

The most striking structural feature of the basin area east of the Arbuckle Mountains is a normal fault system and a complex network of fault blocks. Structures in the basin are similar to those in the mountains and probably resulted from the Ouachita, Wichita, and Arbuckle orogenies. The oil-producing structures in the area are sharp anticlinal features bounded by normal faults which control the entrapment of hydrocarbon accumulations. — SEF

Harris, Bernard. *See* Giacconi, Riccardo. 06014

05970 **Harrison, W. W.; Berry, F. E.** Use of integration readout techniques for low absorbance samples in atomic absorption spectroscopy: Anal. Chim. Acta, v. 47, no. 3, p. 415-423, illus., tables, 1969.

An analog integrator is described and evaluated for the application of integrator techniques to low absorbing solutions by atomic absorption spectroscopy. Use of solid state operational amplifiers allows a stable low drift integration of information signals to improve signal-to-noise ratios. The effects of experimental parameters are described and integration working curves are shown for solutions absorbing with 0-4 percent range. — Authors' abstract

06060 **Harriss, Robert C.; Troup, Arthur G.** Freshwater ferromanganese concretions — Chemistry and internal structure: Science, v. 166, no. 3905, p. 604-606, illus., table, 1969.

Studies by optical microscopy, X-ray diffraction, and electron-probe techniques of ferromanganese concretions from three Canadian lakes reveal chemical banding of amorphous hydrated iron and manganese oxides. The average ratio of iron to manganese in concretions from these lakes varies from 0.43 to 2.56. The concentrations of cobalt, nickel, copper, and lead are one to two orders of magnitude below those reported for oceanic ferromanganese concretions. — Authors' abstract

Harshman, E. N. *See* Society of Economic Geologists. 05775

05712 **Hartung, J. B.; Dence, M. R.; Adams, J. A. S.** Application of the K-Ar method to the dating of shocked rocks — The Brent Crater [abs.]: Meteoritics, v. 4, no. 3, p. 183-184, 1969.

05941 **Harvill, Lee Lon.** Deformational history of the Pelona Schist, northwestern Los Angeles County, California [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1755B, 1969.

06346 **Harwood, David S.; Larson, Richard R.** Variations in the delta index of cordierite around the Cupsuptic pluton, west-central Maine: Am. Mineralogist, v. 54, nos. 5-6, p. 896-908, illus., tables, 1969.

The Δ-index of 52 specimens of cordierite from an aluminous hornfels increases from 0.23 to 0.29 inward toward a quartz monzonite pluton. The MgO/(MgO+FeO) ratio in cordierite from the assemblage, cordierite - biotite - Al silicate - muscovite - quartz - plagioclase - magnetite ± ilmenite ± pyrrhotite ± graphite(?), does not vary significantly toward the intrusive body. The Δ-index is independent of slight changes in MgO/(MgO+FeO) ratio and in the $Al_2O_3/(Al_2O_3+SiO_2)$ ratio. Beryllium content in five samples ranges from 7 to 15 ppm and varies inversely with the Δ index. Minor variations in beryllium content may reflect ability of various structural states of cordierite to accomodate beryllium. Local variations in the Δ-index are related in a qualitative way to variations in thethermal environment. — *from* Authors' abstract

Hastie, L. M. *See* Savage, J. C. 06012

06308 **Hathaway, John C.; Degens, Egon T.** Methane-derived marine carbonates of Pleistocene age: Science, v. 165, no. 3894, p. 690-692, illus., table, 1969.

In some calcium carbonate-bearing sandstones from the edge of the continental shelf off the northeast United States, the δC-13 range is from -30 to -60 per mil for both aragonite and high-magnesium calcite. The δC-13 of coexisting shells of *Modiolus* sp. is normal (+ 1.7 to -2.7 per mil). The δ0-18 values of around + 3.5 per mil in all samples suggest deposition at temperatures around 0°C. Quaternary methane oxidized either chemically or microbiologically to carbon dioxide is the probable source of carbon in these carbonates. — Authors' abstract

06111 **Hauer, Peter M.** Caves of Massachusetts: Altoona, Pa., A Speece Production, 62 p., illus., 1969.

A guide to the known caves of Massachusetts is presented with descriptions, locations, history, and legends. A section on the geospeleology, by Arthur N. Palmer is cited separately. — GDC

06201 **Hauptman, C. M.** Gypsum in Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 233-236, illus., 1969.

Gypsum of commercial importance occurs in nearly pure beds in marine rocks of Mississippian to Jurassic age. The three main areas of occurrence are: the north flank of the Big Snowy and Little Belt Mountains, the east and west flanks of the Prior and Bighorn Mountains, and scattered deposits south of the Gravelly and Madison Ranges. The main deposits are in the Piper Formation of Jurassic age; those in the Kibbey and Otter Formations are large but are not yet developed in central Montana. Gypsum is also worked from the Piper in south-central Montana. Those deposits in the southwest are not yet developed because of the economic circumstances. — HRC

06309 **Hawkins, James W., Jr.; Whetten, John T.** Graywacke matrix minerals — Hydrothermal reactions with Columbia River sediments: Science, v. 166, no. 3907, p. 868-870, tables, 1969.

Experiments with sands chemically similar to graywackes produced "matrix" minerals at 250°C and a water pressure of 1 kb. Starting materials were moderately

well sorted sands containing abundant volcanic rock fragments and no detectable clay minerals. The results support the concept that graywacke matrix may form diagenetically by hydration and recrystallization of unstable clasts. Matrix need not be a recrystallized detrital fine fraction. Texture, therefore, is not a reliable criterion for sandstone classification. For graywackes, chemical composition may be more significant. — Authors' abstract

05914 **Hayes, David Wayne.** A study of the distribution of the lanthanide elements in the Gulf of Mexico using neutron activation analysis [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1782B, 1969.

Hazel, Joseph E. *See* Cheetham, Alan H. 05784

Healy, J. H. *See* Pakiser, L. C. 06047

Healy, J. H. *See* Hamilton, R. M. 06059

05697 **Helsley, Charles E.** Magnetic reversal stratigraphy of the Lower Triassic Moenkopi Formation of western Colorado: Geol. Soc. America Bull., v. 80, no. 12, p. 2431-2450, illus., tables, 1969.

Oriented cores, taken at stratigraphic intervals of 9-12 inches, have been collected from the basal 500 feet of the Moenkopi Formation. The NRM and demagnetized data indicate that the Lower Triassic magnetic field is characterized by at least 11 reversals. This magnetic reversal stratigraphy is tentatively correlated with that of the Chugwater Formation in Wyoming. Polarity reversal sequences may be a useful means of both regional correlation and of identifying oceanic magnetic anomaly patterns associated with sea-floor spreading. — AG

06123 **Helz, A. W.; Walthall, F. G.; Berman, Sol.** Computer analysis of photographed optical emission spectra: Appl. Spectroscopy, v. 23, no. 5, p. 508-518, illus., tables, 1969.

A recording system and computer can be used for the complete spectrochemical analysis of photographed spectra. Transmission values, taken at equal intervals of travel along the spectrum are transferred to magnetic tape with high precision, high speed, and in a form suitable for computer processing. This processing may include wavelength determination, line identification, and plate calibration. — Authors' abstract

Henderson, Edward P. *See* Jarosewich, Eugene. 05714

Henderson, Edward P. *See* King, Elbert A., Jr. 05715

06043 **Henderson, J. F.** (compiler). Current research in the geological sciences in Canada 1968-69: Canada Geol. Survey Paper 69-5, 211 p., 1969.

Research projects listed in this compilation are mainly from universities, federal and provincial departments of mines, and other nonindustrial institutions carrying on research in the geological sciences in Canada; in general it does not include research by mining and oil company geologists. Projects are listed under the headings: areal geology; data storage, retrieval and manipulation; engineering geology; geochemistry; geochronology; geomorphology and glaciology; geophysics; mineral deposits; mineralogy; paleontology; petrology and petrography; Quaternary geology and ground water; sedimentation and sedimentary petrology; stratigraphy and paleontology; and structural geology and tectonics. An author index is included. — MCM

Henderson, Patricia L. *See* Ludwick, John C. 06262

Henkel, D. J. *See* Sangrey, D. A. 05984

Henslee, Walter. *See* McAtee, James L., Jr. 05811

Hepp, David M. *See* High, Lee R., Jr. 06227

06316 **Herpers, U.; Herr, W.; Wölfle, R.** Evaluation of ^{53}Mn by (n,γ) activation, ^{26}Al and special trace elements in meteorites by γ-coincidence techniques, Paper 32 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 387-396, tables, 1969.

Cosmic-ray-produced Mn-53 and Al-26 were measured in a large number of meteorites by intense neutron bombardment or by 'low-level' γ-coincidence techniques. Techniques and merits of the methods are discussed. Conclusions on 'exposure ages' were drawn by comparing results with others based on rare-gas contents. The fact that Mn-53 should be present also in extraterrestrial cosmic dust led to a search for this nuclide in deep-sea sediments for data on the cosmic-dust influx rate. Co-60 was measured in three recently fallen meteorites and a systematic search was carried out simultaneously for trace-element compositon (Mn,Co,Cu,Re,Os,Ir) of iron meteorites with emphasis on nondestructive analysis. — VSN

05871 **Herr, W.; Skerra, B.** Mössbauer spectroscopy applied to the classification of stone meteorites, Paper 11 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 106-122, illus., tables; discussion, p. 150-151, 1969.

Mössbauer spectroscopy is a valuable tool for quantitative analysis of a large number of mixed iron-containing mineral components in stone meteorites which are commonly classified on basis of Fe distribution in oxidized and reduced states. About 60 stones, including 6 carbonaceous chondrites, were quantitatively analyzed and classified by their Mössbauer characteristics in agreement with their conventional grouping. The resulting Prior plot of falls gives evidence for the validity of the second Prior rule within each individual group. From this it is concluded that in formation of ordinary chondrites two different parent bodies were involved, each separately and successively oxidized. Weathering led to formation of hydrated Fe(III) and FeO(OH) which offers a possibility for distinguishing between finds and falls. — VSN

Herr, W. *See* Herpers, U. 06316

Hetherington, E. A., Jr. *See* Denison, R. E. 06126

Hetherington, E. A., Jr. *See* Denison, R. E. 06319

Heusser, G. *See* Spannagel, G. 05845

05849 **Heymann, D.; Mazor, E.; Anders, E.** Ages of the Ca-rich achondrites, Paper 37 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 444-457, illus., tables; discussion, p. 462-463, 1969.

Mass-spectrometric measurements were made of He, Ne, and Ar in 25 eucrites, 2 howardites, and in separated mineral fractions of 5 eucrites. [Techniques are described.] Radiation ages range from 0.1 to 62 × 10^6 yr with some evidence for grouping at 5 and 11 × 10^6 yr. The gross age-distribution is similar to that of ordinary chondrites, especially hypersthenes and amphoterites. Hence, the Ca-rich achondrites seem to come from the same parent bodies as most chondrites or from bodies with very similar orbital elements. It appears certain that more than one half of the U-He and K-Ar ages are strongly discordant. Roughly one half of the K-Ar ages are 2 × 10^8 yr or more older than the corresponding U, Th-He ages, with most between 3 and 4 × 10^9 yr. This strong discordance favors late reheating of parent body. — *from* Authors' abstract

Hiesböck, H. G. *See* Dörfler, G. 05837

06164 **Higgins, Gary H.** Response of rocks to stress, *in* Properties of matter under unusual conditions (in honor of Edward Teller's 60th birthday) (Hans Mark and Sidney Fernbach, editors): New York and London, Interscience Publishers, p. 43-71, illus., tables, 1969.

Phenomena related to rock stress are earthquakes, meteor impacts, and explosions either natural, as from volcanoes, or manmade, as in mining, quarrying, or underground nuclear explosions. The more important publications of recent years are summarized with inclusion of data on rocks, methods of measurement, and equations relating observed properties. While mean confining pressure and principal stresses can be discussed independently for theoretical or laboratory experimental treatments, the environment can place rather great restrictions on modes of possible response of rocks. Studies of nuclear explosions have yielded considerable detailed information of both experimental and theoretical nature concerning response of rocks to stress. — MCM

High, Lee R., Jr. *See* Picard, M. Dane. 05681

06227 **High, Lee R., Jr.; Hepp, David M.; Clark, Thomas; Picard, M. Dane.** Stratigraphy of Popo Agie Formation (Late Triassic), Uinta Mountain area, Utah and Colorado, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 181-192, illus., 1969.

The Popo Agie is conformable on the underlying Gartra Formation and consists of, in ascending order, purple, ocher, and carbonate units. The latter in Colorado is replaced by a sandstone and conglomerate. Locally, the ocher is thin or absent due to the varying thickness of the underlying purple unit. The formation underlies unconformably the Nugget Sandstone. The Gartra and Popo Agie were deposited in a lacustrine-fluvial complex that covered most of western Wyoming and adjacent areas. In general, the purple unit was deposited by lower gradient streams than the Gartra. The ocher and carbonate units were deposited in a lake. Much of the purple and ocher units came from a volcanic provenance. — *from* Authors' abstract

05922 **Hintenberger, H.; Schultz, L.; Weber, H.** Rare gases in the iron and in the inclusions of the Campo del Cielo meteorite, El Taco, Paper 71 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 895-900, illus., tables; discussion, p. 933-934, 1969.

Concentrations of light rare gases were measured in the iron phase of El Taco fragment of Campo del Cielo meteorite, and light and heavy rare gases determined in two silicate inclusions. Besides a radiogenic component, a considerable amount of trapped rare gases was found, with an abundance distribution similar to that in enstatite chondrites. Especially notable is the large excess of Xe-129. While the ratio Xe-129/Xe-132 in atmospheric xenon is 0.983, in a separated silicate fraction of this meteorite an inclusion ratio of 3.85 was observed. Concentration of excess xenon is within the order of magnitude of 10^{-18} cm^3/g in inclusions investigated. Different grain size fractions show the same Xe-129 excess to within 10 percent, whereas concentrations of other xenon and krypton isotopes show strong grain-size dependence, thus indicating that origin of Xe-129 excess has nothing to do with origin of residual xenon.— *from* Authors' abstract

05975 **Hirsch, A. Adler.** Basin tracer curves interpreted by basic analytics: Am. Soc. Civil Engineers Proc., v. 95, paper 6951, Jour. Sanitary Eng. Div., no. SA6, p. 1031-1050, illus., tables, 1969.

A basin flow tracer test with pulse injection is essentially passage of a material shock wave; virtual transit is related to maximum slope on dimensionless time versus concentration curve. The plug point is at initial arrival of tracer for straight or convex upward ascents. The plug fraction of flow extends from origin to plug point; dual flow from there to descending inflection, beyond which flow is of mixed or eddied type. Short circuiting is indicated directly by distance between plug point and nominal detention time. The negative exponent of semilogarithmic plot of the decline denotes number of times the effective fraction of basin volume is extracted by nonplug flow. Replots of published curves confirm this theory. Dispersion is measured by angle between the tangent to the plug point and the vertical. A concise diagram with plug point and dispersion as coordinates permits comparison of basins. — *from* ASCE abstract

06042 **Hitchon, Brian; Friedman, Irving.** Geochemistry and origin of formation waters in the western Canada sedimentary basin — [Pt.] 1, Stable isotopes of hydrogen and oxygen: Geochim. et Cosmochim. Acta, v. 33, no. 11, p. 1321-1349, illus., tables, 1969.

Stable isotopes of hydrogen and oxygen, together with chemical analyses, were determined for 20 surface waters, 8 shallow potable formation waters, and 79 formation waters from oil and gas fields in the western Canada sedimentary basin. The observed isotope ratios can be explained by mixing of surface water and biogenically modified sea water, accompanied by an exchange of isotopes between water and carbonate minerals which causes a major O-18 enrichment. Qualitative evidence confirms the isotope fractionation of deuterium on passage of water through micropores in shales. — DBV

Hodge, Dennis S. *See* Smithson, Scott B. 06006

06296 **Hoekstra, Pieter.** The physics and chemistry of frozen soils, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 78-90, illus., tables, 1969.

The engineering properties of frozen soils are very dependent on temperature in the range from 0°C to -10°C. The temperature-dependence is related to changes in the amount of unfrozen water. The effect of temperature is most pronounced in soil types that contain large quantities of unfrozen water. The amount of unfrozen water increases in the direction sand>silt>clay. — Author's summary

05925 **Holden, William Robert.** Permeability microstratification in natural sandstones [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1638B-1639B, 1969.

06342 **Hollister, Lincoln S.** Contact metamorphism in the Kwoiek area of British Columbia — An end member of the metamorphic process: Geol. Soc. America Bull., v. 80, no. 12, p. 2465-2493, illus., tables, 1969.

Compositional zoning in garnets from this high-pressure contact metamorphic area is a result of depletion of the constituent elements of garnet from a homogeneous matrix, the composition of which thus changes when the garnet grows. Garnet, as well as staurolite, and possibly ilmenite that do not equilibrate internally are termed "refractory" phases. Biotite, chlorite and muscovite equilibrate in response to changing external condition and thus form a matrix. Differences between measured electron microprobe profiles of garnet and those calculated from a depletion model are due mainly to the effect of Mn on the Mg/Fe ratio in the garnet and partly to changing relative proportions of chlorite, muscovite and biotite during the growth of the garnet. Higher grade assemblages seem to have bypassed the lower grade assemblages; they grew at nearly constant temperature. — AH

Holloway, John R. *See* Burnham, C. Wayne. 05973

05982 **Holubec, I.; Finn, P. J.** A lateral deformation transducer for triaxial testing [with French abs.]: Canadian Geotech. Jour., v. 6, no. 3, p. 353-356, illus., 1969.

As research is expanding into more detailed study of stress-strain behaviour of soils in the triaxial test, it is necessary to develop new techniques for measuring more accurately loads and deformations. However, the necessary measuring equipment is not always available commercially. The writers have developed a transducerized apparatus to measure the diameter of triaxial samples, and information on the design and characteristics are presented in this research note. — Authors' abstract

Honda, Masatake. *See* Shima, Masako. 05862

Honea, R. M. *See* Keighin, C. William. 06324

Hopkins, J. C. *See* Gosar, A. J. 06232

Hoppe, M. *See* Shirck, J. 05873

Hori, Minoru. *See* Aki, Keiiti. 06269

05698 **Horne, Gregory S.** Early Ordovician chaotic deposits in the central volcanic belt of northeastern Newfoundland: Geol. Soc. America Bull., v. 80, no. 12, p. 2451-2464, illus., 1969.

Boulder-bearing argillite of the Dunnage Formation is exposed over a large area in southeastern Notre Dame Bay, Newfoundland. The unit, which may be thousands of meters thick, underlies Caradocian graptolite-bearing slates. The larger fragments within the formation are graywacke boulders and lava blocks hundreds of meters long; smaller clasts are many types of native and exotic sedimentary, volcanic and plutonic rocks. Like the argille scagliose of the Italian Apennines, the chaos of the Dunnage Formation is of polygenetic origin. The mixing of mud with consolidated and unconsolidated clasts by submarine slides resulted in a sedimentary deposit that was secondarily remobilized into a chaotic mélange. The mélange records early Ordovician tectonic movements in Newfoundland; coeval movements in western Ireland were of an almost identical nature. — ATO

05776 **Houston, Robert S.** Aspects of the geologic history of Wyoming related to the formation of uranium deposits, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 67-79, illus., table, 1969.

Precambrian rocks are exposed in cores of uplifts, and possibly early Precambrian granites were the source of uranium in Tertiary host rocks. Paleozoic rocks occur along flanks of Laramide uplifts and in low-angle thrusts. The only significant uranium deposits are low-grade, but extensive, in phosphatic rocks. Mesozoic rocks are thicker, and locally Cretaceous sandstones are major hosts for uranium. Deformation began in Cretaceous, and in early Eocene relief reached a maximum and thick beds of coarse conglomerate were deposited. Lakes formed in the basins and uraniferous phosphates occur in the lake deposits. Ash beds are abundant in the Oligocene and later Tertiary. Alternatives for formation of Eocene uranium deposits are considered; it is suggested that they may be an end product of a long complex sequence of events, with redistribution near the end of the Pliocene. — ESL

06260 **Howard, James D.** X-ray radiography for examination of burrowing in sediments by marine invertebrate organisms: Sedimentology, v. 11, nos. 3-4, p. 249-258, illus., 1968 [1969].

Examination of the primary sedimentary texture of rocks and sediments by X-radiography can be extended to include the study of bioturbation of burrowing organisms. The technique involves making time-lapse X-radiographs while the animals are in the process of disturbing the sediment. Artificially and naturally stratified sediments are contained in plexiglass aquaria connected to a continuously-flowing seawater system. The burrowing animals to be studied are introduced into these aquaria and the effect of their activities on the sediments is recorded by X-radiography over a period of hours, days or weeks. — Author's summary

06341 **Hsu, L. C.; Burnham, C. W.** Phase relationships in the system $Fe_3Al_2Si_3O_{12}$-$Mg_3Al_2Sib3O_{12}$-H_2O at 2.0 kilobars: Geol. Soc. America Bull., v. 80, no. 12, p. 2393-2407, illus., tables, 1969.

The above system (almandine-pyrope-water) was investigated at 2 kb fluid pressure under controlled oxygen fugacities. The phase relations are strongly influenced by bulk composition. At high temperature garnet coexists in equilibrium with quartz + 2 spinels, cordierite + quartz + spinel, and cordierite + olivine + spinel; at lower temperature it is in equilibrium with quartz + chlorite + spinel, cordierite + chlorite + quartz, cordierite + orthoamphibole + chlorite, and cordierite + orthoamphibole + spinel, both listed in the order of increasing pyrope content in the bulk composition. Garnet is always richer in Fe than the coexisting Fe-Mg silicates. From bulk compositions containing more than 35 parts pyrope orthopyroxene garnet will crystallize at temperatures above 800° C. — AH

05773 **Hubbard, Fred H.** The proportionality of quartz in myrmekite — A contribution to the discussion [of paper by E. R. Phillips and M. D. Ransom, 1968]: Am. Mineralogist, v. 54, nos. 5-6, p. 988-989, 1969.

In a theoretical model for exsolution myrmekite growth (Hubbard 1967), vein perthite and myrmekite are envisaged as parallel phenomena produced in an early exsolution involving nucleation at preferred sites. At one stage, exsolution of plagioclase accompanied by quartz is considered to take place at lattice disarray sites, to form vein perthite with quartz at internal sites, and myrmekite at the crystal periphery. — ESL

Hulen, J. B. *See* Picard, M. Dane. 05671

Hull, J. E. *See* Meyer, F. W. 06077

06231 **Hummel, J. M.** Anatomy of a gas field — Clay Basin, Daggett County, Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 117-126, illus., tables, 1969.

Gas is produced from the Dakota and Frontier Sandstones in an anticline along the southern margin of the Green River basin. The anticline parallels and is considered genetically related to the Uinta Mountain uplift, the northern fault being a few miles south of the field. The section from the Cretaceous down to the Precambrian as mapped in the field is described briefly. — HRC

06258 **Hummel, J. M.; Chojnacki, Richard.** Results of a census of Utah geologists, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 41-43, illus., 1969.

Seventy-one percent of 448 questionnaires sent to Utah geologists reveal that five are no longer employed, 25 reside outside of the state, 46 are in government work, 38 percent are in mining of some sort, 19 percent are in petroleum geology, 12 percent are in education, and 9 percent are self-employed consultants. Eight percent did not indicate any principal employment activity, and 2 percent could not be classified. The age and the experience graphs are skewed toward the youthful side. Few geologists are over 48 years old, most of these being in management and so out of the field in Utah. — HRC

Huneke, J. C. *See* Nyquist, L. E. 06338

Huneke, J. C. *See* Schultz, L. 06339

Hunt, Graham R. *See* Ross, Howard P. 05959

Huss, G. I. *See* Keil, Klaus. 05863

Imamura, Mineo. *See* Shima, Masako. 05862

06253 **Intermountain Association of Geologists; Utah Geological Society; Lindsay, James B.** (editor). Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists, 16th annual field conference, 1969: Salt Lake City, Utah, Utah Geol. Survey, 237 p., illus., geol. maps, 1969.

This guidebook for the 16th annual field trip of the Intermountain Association of Geologists emphasizes the geology of the north slope of the Uinta Range. The guidebook contains 29 papers (cited separately) of general interest regarding the geology of the area, and road logs for a three day field trip, the last day being a float trip on the Green River. — HRC

06185 **International Seismological Centre.** Regional catalogue of earthquakes, V. 2, No. 1, 1965 January-June: Edinburgh, Scotland, Internat. Seismol. Centre, 248 p., tables, 1969.

This catalog is an index to epicentral determinations for the first six months of 1965. The introduction contains notes on presentation of data and methods of computation; and lists of contributing agencies, all seismological observatories known to the

Centre, and seismic and geographical regions which provide the basis of the sorting process. The major earthquakes are grouped into: shallow focus (depth <60 km), m>5.5; intermediate focus (60 km<depth<300 km), m>5.5; and deep focus (depth >300 km), m>5. Events which have been reported to the Centre as known or probable explosions, and events arranged in seismic and geographical regions and in chronological order within each region are listed. — *from* preface

06259 **Irwin, James H.; Morton, Robert B.** Hydrogeologic information on the Glorieta Sandstone and the Ogallala Formation in the Oklahoma Panhandle and adjoining areas as related to underground waste disposal: U.S. Geol. Survey Circ. 630, 26 p., illus., tables, geol. map, 1969.

Available information indicates that in the Panhandle area the Glorieta Sandstone lies at depths ranging from about 500 to 1,600 feet below the base of the Ogallala Formation; rocks between are of relatively impermeable types, but solution and removal of salt has resulted in collapse of rocks in some places. Collapse and fracturing of rocks could result in increased vertical permeability, which might result in movement of brine under hydrostatic head from the Glorieta into overlying freshwater aquifers. Abandoned or inadequately sealed boreholes also are possible conduits for such fluids. Although this mixing is not known to have occurred, available information is not adequate to show positively whether or not this may have occurred locally. Additional information on stratigraphy and hydrology is needed before conclusions can be drawn. — *from* Authors' abstract

Irwin, Richard M. *See* Leighner, Kurt F. 06177

Irwin-Williams, Cynthia. *See* Szabo, Barney J. 06245

06116 **Isphording, W. C.; Lodding, William.** Facies changes in sediments of Miocene age in New Jersey, *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions—Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 7-13, illus., tables, 1969.

Miocene sediments crop out in a northeast-southwest trending belt in the New Jersey Coastal Plain and can be traced, almost continuously, from Delaware Bay to Raritan Bay. Two formations have been recognized for this time interval, (1) the middle Miocene Kirkwood Formation and (2) the upper Miocene Cohansey Sand. Both of these formations dip seaward at less than 50 feet per mile and are of interest not only because lithologic changes within them reflect clearly the final advance and withdrawal of the late Tertiary seas but also because of the controversial nature of their contact [believed here to be essentially conformable; comparisons of mineral contents are presented]. — Authors' introduction

06191 **Jack, R. N.; Carmichael, I. S. E.** The chemical 'fingerprinting' of acid volcanic rocks, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 100, p. 17-32, illus., tables, 1969.

Quaternary rhyolites and dacites from California, southern Oregon, and western Nevada have been analyzed for Ti, Mn, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, Nb, Ba, La, Ce, Pr, Nd, Pb and Th. Concentrations of Ba, Sr, Zr vary considerably with source localities of samples. These differences may be used to characterize or 'fingerprint', with one exception, the acid extrusive rocks from each eruptive center. These data indicate that the source material and/or physico-chemical genetic process of these acid volcanic rocks has varied from center to center. However, the ratio K/Rb varies regularly with increase in K and has an average value of 234 for the rhyolites. Exploratory data have been used to suggest, or eliminate, possible eruptive sources for ash deposits and also sources of obsidian used as raw material for California Indian artifacts. — *from* Authors' abstract

05790 **Jackson, D. E.; Etherington, J. R.** New Silurian cyrtograptid graptolites from northwestern Canada and northern Greenland: Jour. Paleontology, v. 43, no. 5, p. 1114-1121, illus., table, 1969.

Cyrtograptus canadensis n. sp. and *C. laqueus* n. sp. are described from several localities in the South Nahanni River region, Mackenzie, Northwest Territories, and in northern Yukon. These are the oldest cyrtograptids known from northwestern Canada and range from late Llandoverian into early Wenlockian. A single specimen designated as *Cyrtograptus* sp. aff. *C. canadensis* is described from the Cape Schuchert Formation (late Llandoverian) in northernmost Greenland. — VMJ

05942 **Jackson, Togwell Alexander.** The role of pioneer lichens in the chemical weathering of recent volcanic rocks on the Island of Hawaii [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1756B, 1969.

05828 **Jain, A. V.; Lipschutz, M. E.** Shock histories of hexahedrites and Ga-Ge group III octahedrites, Paper 66 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 826-837, illus., tables; discussion, p. 842, 1969.

To test results of a previous study of chemical group III meteorites (1967), which indicated that these meteorites had been shocked to pressures above 130 kb or thermally altered by some long-term heat source, a new study was made of 35 known or suspected Ga-Ge group III meteorites. Derivation from a single Ring asteroid disrupted by a collision 650 m.y. ago was suggested in the first study. The collision played an important role in the ultimate capture by Earth of the group III fragments; pressures above 130 kb are prerequisites for earth-capture if a Ring asteroid is the parent. Only main-sequence (chemical groups III) octahedrites show evidence that shock played an important role in eventual capture. Studies of shock effects in hexahedrites indicate that these meteorites have not been subjected to sufficient shock pressure to permit escape from the Moon; they probably were derived from Apollo asteroids. — VSN

05713 **Jain, Anant V.; Lipschutz, Michael E.** Shock histories of iron meteorites — An interim report [abs.]: Meteoritics, v. 4, no. 3, p. 185, 1969.

05826 **Jambor, J. L.** Muskoxite — A new hydrous magnesium-ferric iron oxide from the Muskox Intrusion, Northwest Territories, Canada: Am. Mineralogist, v. 54, nos. 5-6, p. 684-696, illus., tables, 1969.

Muskoxite is found with serpentine in small fractures in drill cores from the intrusion. Chemical analysis gave Fe_2O_3 41.1, FeO 0.0, MgO 35.4, H_2O 23.8. [Results of thermogravimetric analyses are given.] Muskoxite is dark reddish brown; streak light orange-brown; hardness about 3; luster vitreous; $p = 3.10$ to 3.20 ± 0.05; perfect basal cleavage; biaxial negative with 2V variable from 15 to 40°, $n = 1.80$-1.81. It occurs typically as aggregates of intergrown minute crystals, less commonly as individual plates with hexagonal outline, paper-thin. The X-ray powder pattern has strongest lines at 4.6 (*s*), 4.4 (*m* to *w*) 2.31 (vs), 1.74 (*m*), 1.46 Å (*w*). Single crystal films indicate that muskoxite is trigonal. — *from* Author's abstract

06050 **James, Odette B.** Shock and thermal metamorphism of basalt by nuclear explosion, Nevada Test Site: Science, v. 166, no. 3913, p. 1615-1620, illus., 1969.

Olivine trachybasalt metamorphosed by nuclear explosion is classified into five categories of progressive metamorphism — weak, moderate, moderately strong, strong, and intense — based primarily on progressive effects in feldspar. The end result is conversion to inhomogeneous basaltic glass. These studies should provide a basis for comparison with lunar samples shocked by meteor impact. — DBV

05714 **Jarosewich, Eugene; Melson, William G.; Henderson, Edward P.** Partitioning of Fe, Ni, Co, Ge and Ga between coexisting metallic and silicate portions of Disko Island basalts, West Greenland [abs.]: Meteoritics, v. 4, no. 3, p. 186, 1969.

Jarosewich, Eugene. *See* Fredriksson, Kurt. 05868

06300 **Jeletzky, J. A.** New or poorly understood Tertiary sepiids from southeastern United States and Mexico: Kansas Univ. Paleont. Contr.-Paper 41, 39 p., illus., 1969.

Restudy of the single specimens of *Belemnosella americana* and *B. floweri* from the middle Eocene upper Claiborne Group of Mississippi and Alabama, respectively, confirms their specific distinction; another specimen from the Claiborne of Alabama is designated as *B.* n. sp., aff. *B. floweri*. Belemnoseidae is emended on the basis of phragmacone structure; *Belemnosella* is now considered a specialized form closely related to *Belemnosis* and farther from the hypothetical root-stock of Tertiary Sepiida than the primitive, taxonomically isolated Vasseuriidae. The Spirulirostridae are interpreted as direct descendants through *Belemnosis*. *Spirulirostra americana* Berry, 1922, Miocene, southern Mexico, is assigned to a new, monotypic genus, *Amerirostra*; no other spirulirostrids are known from the Americas. — VMJ

Jenkins, C. T. *See* Moulder, E. A. 05699

05921 **Jester, Guy Earlscort.** An experimental investigation of soil-structure interaction in a cohesive soil [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1671B-1672B, 1969.

Jhaveri, Dilip P. *See* Liu, Shih-Chi. 05968

Johns, W. D. *See* Bissada, K. K. 05960

06286 **Johnson, J. Harlan.** Lower Permian algal stromatolites from Kansas and Oklahoma — Pt. 2, Algal stromatolites from the Wellington Formation of Kansas and Oklahoma: Kansas Univ. Paleont. Contr.-Paper 43, p. 9-19, illus., tables, 1969.

The mega-microscopic aspects of Wellington stromatolites were studied. Flat, laminated, domal, hemispheric, digitate, and spherical masses are characteristic forms. Laminae are paired: darker layer (organic), lighter layer (silt chiefly). Study of thin sections suggests detrital influence (possible control) on laminae. Thus, where detrital inflow was abundant, laminae are distinct and fairly thick; where it lessened, dark layers are thicker and darker, while the light layers appear thin to absent; and if detritus was completely absent, laminae become indistinct. Algal threads observed in thin sections include vertical threads 18-23μ in diameter and horiontal threads with well-developed walls 25-30μ thick. — Author's abstract

06000 **Johnston, W. G. Q.** Pillow lava and pahoehoe — A discussion [of paper by J. G. Jones, 1968]: Jour. Geology, v. 77, no. 6, p. 730-732, 1969.

Johnston's arguments favor development of pillows as discrete individuals; those of J. G. Jones (ibid., v. 76, no. 4, p. 485-488) favor budding, as in subaerial pahoehoe. — REW

Jones, Thomas A. *See* Speed, Robert C. 05691

Jordan, Dianne. *See* Beerbower, James R. 05796

Jorgensen, D. G. *See* LeRoux, E. F. 05705

Jovanovic, S. *See* Reed, G. W. 05728

05786 **Kaesler, Roger L.; Fisher, William Lee.** Population dynamics of *Triticites ventricosus* (Fusulinacea), Hughes Creek Shale, Kansas: Jour. Paleontology, v. 43, no. 5, p. 1122-1124, illus., table, 1969.

From a 1000 cm^3 sample containing nearly 13,500 fusulinids of the species *Triticites ventricosus* [Permian, Wolfcampian, Wabaunsee County, Kans.], number of chambers (X) of 5166 individuals was estimated from length in millimeters (Y) using the regression equation $Y = 0.114 + 0.369X$. A composite life table and survivorship curve indicate lowest mortality rate among individuals with 60 to 69 chambers. Juvenile mortality rate is much lower than that of some other marine organisms, suggesting that early growth may have taken place in a reproductive cyst. — Authors' abstract

05848 **Kaiser, W.; Zähringer, J.** K/Ar-age determinations of iron meteorites V, Paper 36 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 429-443, illus., tables; discussion, p. 461-462, 1969.

Improved techniques used in neutron activation analysis of 24 iron meteorites for K and Ar-40 are described. Troilite was analyzed also in Hoba and Odessa, schreibersite in Odessa and Sikhote-Alin, and silicates in Odessa. K/Ar ages of Carthage, Chesterville, Odessa, and Tombigbee River were found to be 4.8 b.y. and for Campo del Cielo, 2.6 b.y.; silicates of Odessa are 4.6 b.y. old. Canyon Diablo, Gundaring, Magura, and Santa Rosa have high K contents and much higher K/Ar ratios; they show signs of weathering and may have suffered K losses. It is pointed out that ages of individual samples are in general without meaning because of the sampling problem and K and Ar diffusion; more or less accurate ages can be obtained by averaging ages from several samples. Many more ages are needed before the 4.8 b.y. age can be confirmed as the time of crystallization of iron meteorites. — VSN

Karner, Frank R. *See* Moore, Walter L. 06090

05788 **Kauffman, Erle G.** Systematics and evolutionary position of a new Tertiary *Thyasira* (Bivalvia) from Alaska: Jour. Paleontology, v. 43, no. 5, p. 1099-1110, illus., 1969.

Thyasira alaskana, n. sp. is a large late Miocene-Pliocene species characteristic of both fossil and living Thyasiridae dominating the Atlantic and Arctic Faunal Realms, being closely related to the living species group of *T. sarsi* (Philippi) and the Late Cretaceous *T. advena-T. becca* species group of Western Interior North America. It occupies an evolutionary position midway between Cretaceous and Recent species and denotes a continuation of the trends toward more efficient burrowing forms described in the Cretaceous members of the lineage. Abundant single and articulated specimens in nearshore conglomeratic sandstone of shallow water, high energy origin are randomly oriented and suggest rapid burial of a transported assemblage, possibly during a storm episode. — Author's abstract

Kaushal, S. K. *See* Gopalan, K. 05707

06324 **Keighin, C. William; Honea, R. M.** The system Ag-Sb-S from 600°C to 200°C [with German abs.]: Mineralium Deposita, v. 4, no. 2, p. 153-171, illus., tables, 1969.

Studies of the system Ag-Sb-S between 600° and 200°C indicate configuration changes near 300°C, and at 200°C the equilibrium assemblages correspond to those usually reported for minerals in ores. Most minerals of the system were synthesized. The synthetic phase of Ag_7SbS_6 (antimony analog of billingsleyite) is characterized: the ease of synthesis in the area bounded by argentite-pyrargyrite-sulfur suggests the probable existence of a mineral of this composition. Stephanite was not formed as a synthetic product in this study. Combined DTA and X-ray data show that at 197 ± 5°C stephanite decomposes in absence of sulfur to form pyrargyrite plus argentite, whereas with excess sulfur products are Sb-billingsleyite plus pyrargyrite. Pyrostilpnite, the low temperature dimorph of pyrargyrite, is unstable above 192 ± 5°C. — *from* Authors' abstract

Keil, Klaus. *See* Bunch, T. E. 05740

Keil, Klaus. *See* Bunch, T. E. 05741

05863 **Keil, Klaus; Huss, G. I.; Wilk, H. B.** The Leoville, Kansas, meteorite — A polymict breccia of carbonaceous chondrites and achondrite [abs.], Paper 20 *in* Meteorite research — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 217; discussion, p. 223, 1969.

Keith, Terry E. C. *See* Foster, Helen L. 06084

06225 **Keller, E. R.; Thomaidis, N. D.; Ritzma, H. R.; Burchell, P. W.** Road logs, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 226-237, illus., 1969.

Detailed mileage road logs for three days of field trips are given. The first day begins at Evanston, proceeds eastward to Rock Springs, and makes three trips into the range from the road. None of the stops are described in detail. The second day is from Rock Springs to Vernal, Utah, across the Uinta Mountains, with six stops. The third day (only one stop by land) is from Vernal eastward into Colorado, thence northward to Echo Park on the Green River where a float trip is taken back toward Vernal, the end. — HRC

Kelley, James C. *See* Whetten, John T. 06244

06307 **Kellogg, William C.** Magnetic observations in studies of sea-floor spreading [discussion of "East-Pacific Rise crest — A near-bottom geophysical profile", by R. L. Larson and F. H. Spiess, 1969]: Science, v. 165, no. 3893, p. 617, 1969.

Larson and Spiess (ibid., v. 163, no. 3862, p. 68-71, 1969) use the terms "surface magnetics" and "deep magnetics" in exact opposition to years of practical usage. Before anyone attempts to interpret magnetic profiles over the sea floor, they should acquaint themselves with available aeromagnetic data, both on- and offshore, to put their conclusions in a perspective dictated by nature's real variability in the fine as well as in the large structure. — DBV

05688 **Kendall, Christopher G. St. C.** An environmental re-interpretation of the Permian evaporite/carbonate shelf sediments of the Guadalupe Mountains: Geol. Soc. America Bull., v. 80, no. 12, p. 2503-2525, illus., tables, 1969.

Shelf sediments of the Delaware basin near the Texas-New Mexico border form a wedge prograding southeastward or basinward. They include shallow-water carbonates, aeolian quartz silts and supratidal evaporites. Depositional environments are: shelf-edge; apron; island barrier and tidal flat complex; lagoons; supratidal flats. The type of carbonate grains formed depended on the rate of $CaCO_3$ precipitation and the hydrodynamics. Low sea level stands produced cliffs, rubble, partial infill of voids with aeolian quartz, and desiccation polygons. High sea level and storm-induced floods resulted in influx of marine sediments into voids, solution of evaporites, dedolomitization and brecciation. Penecontemporaneous cementation, neomorphism and dolomitization occurred in highly saline, marine-derived waters. — *from* Author's abstract

Kennedy, Michael P. *See* Bukry, David. 06194

06216 **Kent, D. M.** Potential hydrocarbon reservoir rocks in the Upper Devonian Saskatchewan Group of western Saskatchewan, *in* Eastern Montana symposium — Montana Geol. Soc.,20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 55-68, illus., 1969.

The upper member of the Birdbear Formation and the middle unit of the Wymark Member of the Duperow Formation have thick, extensive occurrences of sucrosic and euhedral dolomite possessing good porosity and permeability which change facies to form a weak permeability barrier. Potentiometric surface maps of fluids in these units show a generally northern updip component of flow interrupted by a low potential region near the Kindersley-Rosetown region. Other local changes also occur. Localities favorable for hydrocarbon accumulation are in areas where the component of fluid flow is downdip toward a permeable barrier in the same direction. The Kindersley-Rosetown area appears to be a prime prospecting locality; several other possible areas are also present. — *from* Author's summary

06190 **Kerr, Paul F.; Drew, Isabella M.** Clay mobility, Portuguese Bend, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 100, p. 3-16, illus., 1969.

An unusual landslide at Portuguese Bend on Palos Verdes Hills west of San Pedro has attracted interest because 160 homes have been affected. Slide movement began in a Monterey Shale member that contains bentonite; samples of bentonite from the tuffaceous rocks are rich in Ca-montmorillonite. This thixotropic clay is stable when dry but swells and flows under pressure when it absorbs water. Overlying stable shale beds are slowly rafted downslope on bentonite-lubricated slip planes. Movements of a small fraction of an inch per day have accumulated in a year from 10-30 feet in places; field observations indicate the slide is constantly enlarging. No completely successful method of controlling the landslide has been developed; adequate drainage on the surface and along the slip plane below would probably greatly reduce sliding. — *from* Authors' abstract

05818 **Kerrick, D. M.** K-feldspar megacrysts from a porphyritic quartz monzonite,central Sierra Nevada, California: Am. Mineralogist, v. 54, nos. 5-6, p. 839-848, illus., tables, 1969.

Microcline megacrysts in samples of quartz monzonite from the Cathedral Peak pluton have higher Ba contents and lower obliquities than groundmass microclines. These observations suggest that the megacrysts crystallized earlier than the groundmass microclines. — Author's abstract

06331 **Kerridge, J. F.** The use of selected-area electron diffraction in meteorite mineralogy, Paper 41 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 500-504, illus., table; discussion, p. 534-535, 1969.

The use of precision goniometer stages on electron microscopes for study of mineral constituents of carbonaceous meteorites is discussed. Results to date have identified olivine positively in a Type I meteorite and indicated a range of composition for olivine in Type II meteorites in agreement with earlier work. Compositional variations are observed among layer lattice silicates from both types and in spinels from Type I. Structural disorder noted in pyroxene and in stacking of layers in layer lattice silicate is believed to be a growth effect, although subsequent shock cannot be ruled out now. Results support the hypothesis that carbonaceous meteorites are mechanical mixtures of minerals, little altered since formation. Mild hydrothermal action is noted on a few minerals. — VSN

Khayatt, A. J. *See* Barden, L. 05983

06167 **Khelil, Chakib.** The effect of differential pressure and clay content on the formation resistivity factor: Log Analyst, v. 10, no. 5, p. 3-11, illus., table, 1969.

The review of existing methods of calculating formation resistivity factors has shown there are limitations on direct use of the formation factor measured at atmospheric conditions for the purpose of calculating water saturation. Errors introduced in the calculation may be large in high differential pressure, high clay content, and low porosity reservoirs when no corrections are made. A procedure has been proposed to derive corrections to the formation factor for the effects of pressure and clay content for a wide range of porosity. Charts showing effects of pressure and clay content for a wide range of porosity have been presented to facilitate the work of the engineer in correcting for them. — *from* Author's conclusions

06125 **Kidson, E. J.; Williams, G. L.** Concentration of palynomorphs by use of sieves: Oklahoma Geology Notes, v. 29, no. 5, p. 117-119, illus., 1969.

Recent availability of sieves with screen-size openings as small as 5 microns (accuracy of $\pm 2\mu$) has made possible rapid size grading of palynomorphs into various close-tolerance units, with a minimum of chemical treatment. Two sieves, 20- and 30- μ mesh, have been used in the laboratory for the past six months to screen macerated samples, and to rescreen residues analyzed in past years. The 20- μ fraction normally contains small organic debris and clay-size particles, with few palynomorphs, and is soon discarded; the $\pm$ 20-30μ fraction consists mainly of pollen and small spores, and the + 30-μ fraction is a concentration of dinoflagellates, larger spores, and bivesiculate pollen. The latter fraction can be further cleaned by heavy-liquid separation if necessary. The sieves are easily cleaned, and contamination is not a problem. — VMJ

Kidson, Evan. *See* Tasch, Paul. 06285

05917 **Kienle, Jürgen.** Gravity survey in the general area of the Katmai National Monument, Alaska [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1830B, 1969.

Kimberlin, Jerome. *See* Wasson, John T. 05700

06214 **Kinard, John C.; Cronoble, William R.** The Winnipegosis Formation in northeast Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 33-44, illus., table, 1969.

The small petroleum accumulations found to date are only leads to the major discoveries of the future. The most appealing area is the bioherm-interbioherm area in the extreme northeast. Production may also come from the dense restricted lagoonal and shallow shoal facies. Recovery in the Pubco-Empire no. 36-10 State-Anderson indicates that the interbioherm facies is capable of commercial production if the proper structural conditions exist. The bioherm facies has the most potential for production. Inherent porosity and permeability produced in part by dolomitization and proximity to possible source beds (deep shoal facies) favor this facies for maximum production. — *from* Authors' summary

05715 **King, Elbert A., Jr.; Henderson, Edward P.** The Del Rio meteorite — A new ataxite from Texas [abs.]: Meteoritics, v. 4, no. 3, p. 187-188, 1969.

05892 **Kirwan, J. L.** Geological history of the Precambrian rocks in parts of the Porcupine mining area, Canada [abs.]: Inst. Mining and Metallurgy Trans., Sec. B, v. 78, Bull. 753, p. B132, 1969.

05819 **Kishk, Fawzy M.; Barshad, Isaac.** Morphology of vermiculite clay particles as affected by their genesis: Am. Mineralogist, v. 54, nos. 5-6, p. 849-857, illus., tables, 1969.

Electron microscopy established that the mode of formation of soil vermiculite clay affects the shape of its particles. When clay vermiculite forms by the alteration of biotite, muscovite, or chlorite the shape of some of its particles resembles that of the parent mineral and appears as large, translucent, irregular polygonal sheets with some of the edges frayed; but a large proportion of its particles appear as thin pseudohexagonal flakes or fragments. When vermiculite forms by synthesis from silica and alumina gels, its particles are mostly small hexagonally-shaped sheets resembling kaolinite. Many of the synthetic particles are also fragmented and have frayed edges and others aggregate into larger hexagonal sheets. Since soil vermiculite clay is frequently associated with kaolinite, the present finding indicates that electron-microscope analysis for the purpose of verifying purity of clay samples based on shape alone may not be reliable. — Authors' abstract

Kiszenick, W. *See* Camp, P. R. 06160

06325 **Kjellesvig-Waering, Erik N.** A new phalangiotarbid (Arachnida) from the Pennsylvanian of Oklahoma: Jour. Paleontology, v. 43, no. 5, p. 1280-1282, illus., 1969.

A new family, Anthracotarbidae, and new genus and species, *Anthracotarbus hintoni*, is described from the Pennsylvanian, upper Cherokee Group of eastern Oklahoma. It is the only Phalangiotarbida known in the western hemisphere outside of the famous Mazon Creek beds of Illinois. — Author's abstract

05893 **Klages, M. G.** Weathering of montmorillonite during formation of Solodic soil — [Pt.] 2, Nature of the mixed layer products: Soil Sci. Soc. America Proc., v. 33, no. 4, p. 543-546, illus., tables, 1969.

X-ray diffraction indicated that montmorillonite disappeared from the clay fraction during formation of a Solodic (Paleargid) soil and associated soils formed on calcareous glacial till. Despite this, quantitative estimates showed little change in clay mineral composition. It was concluded that during soil formation, relatively pure

mineral crystals were altered to particles containing several 2:1 minerals in a highly random arrangement of various degrees of interlayer expansion. — Soil brief

06056 **Knox, Arthur S.** Glacial age marsh, Lafayette Park, Washington, D.C.: Science, v. 165, no. 3895, p. 795-797, illus., 1969.

Organic sediments beneath historic Lafayette Park mark the site of a freshwater marsh which bordered the Potomac River when it was 15 m above its present level. Plant microfossils and ice-rafted boulders indicate a climate much colder than now. The carbon-14 age of more than 45,000 years and palynological studies suggest an early Wisconsinan age. — Author's abstract

05716 **Knox, Reed, Jr.** The yield strength of meteoritic iron [abs.]: Meteoritics, v. 4, no. 3, p. 188, 1969.

05987 **Koenig, James B.** The Geysers geothermal field 1969: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 8, p. 123-128, illus., tables, 1969.

The Geysers, Calif., the only successful geothermal power facility in the United States, is underlain by a thick sequence of graywacke, interbedded shale and basalt, and concordant serpentine and diabase bodies. Major northwest trending fault zones with cumulative throw of 10,000 to 20,000 feet, are present in the Mayacmas Mts., which may be a horst. A table shows the history of 10 thermal areas around Clear Lake. The Geysers were discovered in 1847 and a resort established. Plans to use the steam were discussed in this century, and eight wells were drilled between 1921 and 1925, but the project failed and none of these are now in use. Geothermal power generation became a reality in 1960. The greatest depth reached by the wells is 8,175 feet. Rates of steam flow suggest a very large reservoir with temperature probably 250-280°C. Hot springs and fumaroles are along faults and shear zones, and most water is of connate origin. — ESL

Kokinos, M. *See* Wise, W. S. 05813

05717 **Kornblum, Joseph J.** The concentration and collection of meteoric dust in the atmosphere [abs.]: Meteoritics, v. 4, no. 3, p. 189-190, 1969.

Koto, Kichiro. *See* Morimoto, Nobuo. 06069

Krause, Dale C. *See* deBoer, Jelle. 06054

Ku, T. L. *See* Broecker, W. S. 06083

05718 **Kullerud, G.; ElGoresy, A.** Sulfide assemblages in the Odessa meteorite [abs.]: Meteoritics, v. 4, no. 3, p. 191-192, 1969.

Kullerud, G. *See* ElGoresy, A. 06333

Kulp, J. Laurence. *See* McDowell, Fred W. 05876

06280 **Kumazawa, Mineo; Anderson, Orson L.** Elastic moduli, pressure derivatives, and temperature derivatives of single-crystal olivine and single-crystal forsterite: Jour. Geophys. Research, v. 74, no. 25, p. 5961-5972, illus., tables, 1969.

Ultrasonic wave velocities in single-crystal forsterite and olivine have been measured as a function of pressure and of temperature near ambient conditions. Shear and longitudinal velocities were measured in 18 independent modes, so that each of the nine elastic constants could be calculated by at least two independent modes. The adiabatic stiffness constants, their temperature derivatives, and their pressure derivatives are tabulated. The density and other isotropic properties including the adiabatic bulk modulus, the shear modulus, the Poisson ratio, and their pressure and temperature derivatives computed by the Voigt-Heuss-Hill method, using the same dimensions as above, are given also. — DBV

05865 **Kurat, G.** The formation of chondrules and chondrites and some observations on chondrules from the Tieschitz meteorite, Paper 17 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 185-190, illus.,; discussion, p. 220-221, 1969.

Analyses of coexisting minerals and interstitial groundmass in chondrules of Tieschitz and Mezö-Madaras chondrites show that chondrules are products of several complex and overlapping processes. Comparison of these chondrules with so-called 'equilibrated' chondrules from these and other meteorites makes clear that those of 'unequilibrated' chondrites have formed under special circumstances. Probably they represent a border-facies of the ordinary process of chondrule formation. Formation of 'equilibrated' from 'unequilibrated' chondrules through thermal metamorphism is thought to be impossible. The Tieschitz meteorite shows no metamorphism, although several chondrules display some alterations which they clearly sustained after agglomeration. — *from* Author's abstract

Labute, G. J. *See* Gretener, P. E. 05991

05992 **Labute, G. J.; Gretener, P. E.** Differential compactions around a Leduc reef — Wizard Lake area, Alberta: Bull. Canadian Petroleum Geology, v. 17, no. 3, p. 304-325, illus., tables, 1969.

The Leduc reefs of central Alberta are surrounded by the Ireton shales. In this stratigraphic interval, differential compaction has induced structure in the overlying formations. We have analyzed the structural deformation of the strata above the Wizard Lake reef. In this area Lower Cretaceous rocks lie unconformably on Upper Devonian strata. Removal of the upper Paleozoic beds has resulted in the loss of part of the compaction record. A quantitative study of the change of structure with depth allows us to estimate the maximum thickness of sediment eroded. For the Wizard Lake area we find that this is about 1750 feet. Reconstruction of a regional cross-section indicates this to be a reasonable value. — Authors' abstract

06289 **Laguros, Joakim G.** Effect of temperature on some engineering properties of clay soils, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 186-193, illus., tables, 1969.

Standard laboratory studies were conducted on 4 clay soils (kaolinitic, illitic, montmorillonitic, and montmorillonitic-illitic) at temperatures of 35, 70, and 105°F with ± 2° deviation. In all four, the liquid limit decreased with increased temperature, and the plasticity index followed the same trend save for the kaolinitic which was slightly the reverse. An increase in strength with an increase in temperature is indicated except for the illitic. The void ratio-pressure relationships resulted in a family of somewhat parallel curves. It is concluded that since slightly higher densities were observed with temperature increases, the thermal energy effects were overcompensated. — *from* Author's abstract

05900 **Lajtai, E. Z.** Mechanics of second order faults and tension gashes: Geol. Soc. America Bull., v. 80, no. 11, p. 2253-2272, illus., 1969.

It is postulated that en-echelon second order shear fractures and tension gashes form under a stress mechanism similar to the one occurring in the direct shear test. Direct shear or modified direct shear state of stress could develop at certain points along a forming primary fault as a result of local reduction in the normal stress acting on planes perpendicular to the displacement direction. In most en-echelon arrays, orientation of the individual fractures reflects a local state of stress and cannot be directly oriented with regional stress field. The fracture zones, however, may represent planes of high effective shear stress regionally. In direct shear for a given set of strength parameters, tension fractures form at low normal stress, shear fractures at intermediate normal stress, and a shear zone at high normal stress. Modified direct shear favors second order faults. — RAL

05860 **Lal, D.; Lorin, J. C.; Pellas, P.; Rajan, R. S.; Tamhane, A. S.** On the energy spectrum of iron-group nuclei as deduced from fossil-track studies in meteoritic minerals, Paper 24 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 275-285, illus., table; discussion, p. 349, 1969.

We present here experimental data on the depth variation of fossil-track densities in the hypersthene and oligoclase crystals sampled from several cores taken from the least ablated regions of the meteorite Saint-Séverin. The implications of these results (and of those in the Patwar meteorite) to the extent of atmospheric/preatmospheric ablation, and to the time-averaged flux and energy spectrum of cosmic-ray iron-group nuclei during the last $10\text{-}50 \times 10^6$ years, are discussed. — Authors' abstract

Lambert, D. G. *See* Archambeau, C. B. 06273

05894 **Lammlein, David R.; Sbar, Marc L.; Dorman, James.** A microearthquake study of southeastern Missouri and western Tennessee [abs.]: Earthquake Notes, v. 40, no. 2, p. 14, 1969.

06007 **Landers, Tom; Claerbout, Jon F.** Effects of thin soft layers on body waves: Seismol. Soc. America Bull., v. 59, no. 5, p. 2071-2078, illus., table, 1969.

The inability of simple layered models to fit both Rayleigh wave and Love wave data has led to the proposal of an upper mantle interleaved with thin soft horizontal layers. Since surface-wave dispersion is not sensitive to the distribution of soft material but only to the fraction of soft material a variety of models is possible. The solution to this indeterminancy is found through body-wave analysis. It is shown that body waves are dispersed according to the thinness and softness of the layers. Three models, each of which satisfy all surface-wave data, are examined. Transmission seismograms calculated for these models show one to be impossible, one improbable, and the other possible. Synthesis of the seismograms is accomplished through the use of time domain theory as the complicated frequency response of the models makes a frequency oriented Haskell-Thompson approach impractical. — Authors' abstract

Langston, R. B. *See* Bailey, S. W. 05964

05719 **Larimer, John.** Fractionation of major elements in chondrites [abs.]: Meteoritics, v. 4, no. 3, p. 193-194, 1969.

06155 **LaRocque, Aurèle.** La repopulation post-glaciaire du Québec par les mollusques extra-marins [with French and German abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 271-279, illus., tables, 1969.

The retreat of the last ice sheet has opened up dispersal routes for the mollusks that lived in the areas bordering the glacier. The study of the sequence of availability of these routes explains to a certain extent the present distribution of Mollusca in Quebec. The latter is here given in a table showing five general areas of the province and according to a list brought up to date by the work of the last ten or fifteen years. The dispersal routes are described in general for nonmarine Mollusca and then those which are peculiar to Quebec are examined more closely. New data acquired from the Pleistocene of Ohio call for some modification of current theories on dispersal routes and more particularly of those leading to Quebec. — Author's abstract

Larsen, William R. *See* Papadopulos, Istavros S. 05704

Larson, Edwin E. *See* Mutschler, Felix E. 05880

06278 **Larson, R. E.; Gordon, G. M.** Geophysical implications of photonuclear production of argon isotopes: Jour. Geophys. Research, v. 74, no. 25, p. 6023-6025, illus., table, 1969.

A new source of argon isotopes has been investigated, photonuclear production by gamma rays acting on natural calcium. The cross section for production of Ar-44 and

Ar-43 by gamma and alpha reactions on Ca-48 has been measured. Extrapolation of this result indicates an upper limit of the order of 0.1 millibarn for the cross section of Ca-40 (gamma, alpha) Ar-36 reaction with approximately 50 Mev gamma rays. This small cross section precludes the formation of significant quantities of Ar-36 to alter age determinations. — GV

Larson, Richard R. *See* Harwood, David S. 06346

06066 **Larson, Roger L.; Spiess, Fred N.** Magnetic observations in studies of sea-floor spreading [Reply to discussion by W. C. Kellogg of "East-Pacific Rise crest — A near-bottom geophysical profile", 1969]: Science, v. 165, no. 3893, p. 618, 1969.

Larson and Spiess (ibid., v. 163, no. 1862, p. 68-71, 1969) were thoroughly familiar with continental magnetic structures, in both large and fine scale. The fine-scale magnetics, only part of the new data presented in the paper criticized by Kellogg (ibid., v. 165, no. 3893, p. 617, 1969), shows a strong tendency toward lineation of the same orientation as the large-scale features where these coexist. — DBV

Latham, Gary. *See* Auld, Bruce. 06033

06149 **Laverdière, Camille; Bernard, Claude.** Le vocabulaire de la géomorphologie glaciaire, [Pt.] 5, *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 351-358, illus., 1969.

Some notes on terminology used by various authors for the same geomorphological features are discussed; included are truncations, resulting from one facet formed by glacial action being intersected by another; till fabric for which there is no French translation save *trame du till*; and glaciofluvial terraces. New terms for geographic features are also proposed, for the most part commemorative after the geologists who first studied them. — HRC

06150 **Laverdière, Camille; Dionne, Jean-Claude.** Les roches dissymétriques de l'est du Lac Saint-Jean [with English abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 358-365, illus., 1969.

Exceptional examples of unsymmetrical rocks occur in the eastern part of the Lake Saint-Jean area (Quebec). Anorthosite bedrock was sculptured by glacier ice and partly buried by marine sediments of the Laflamme gulf. The tops of many knolls outcrop at many places throughout the clay plain, giving outstanding pictures of whaleback rocks. Like many small scale features of glacial abrasion (striations, grooves, chattermarks, etc.), streamline molded forms (drumlins, fluted surfaces, etc.) or drift accumulation (indicators, end moraines, eskers, etc.), unsymmetrical rocks are useful landforms to determine the general direction of movement of a former glacier, from the stoss side towards the lee side. — Authors' abstract

06157 **Laverdière, Camille.** Le retrait de la calotte glaciaire de Scheffer–Du Témiscamingue au Nouveau-Québec [with English and Russian abs.], *in* Le naire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 233-246, illus., 1969.

At a certain time of its existence, the southern front of the last ice sheet had a large embayment towards the Temiscaming area; the northern front was receding from Hudson and James Bay towards the Abitibi area. This mode of recession led the ice to break up into two caps: one lobe receded towards northern Ontario and Manitoba, the other towards central New Quebec. The latter is the Scheffer ice sheet; its area of melting is characterized by an assemblage of ice decrepitude morainic as well as glaciofluvial forms. Glacial Lake Barlow-Ojibway was kept by dead ice in the Temiscaming trough; the so-called winter moraines are indicators of rate of ice recession, and the Cochrane-Amos readvance was contemporaneous with the Tyrrell Sea transgression. — *from* Author's abstract

Laverdière, Camille. *See* Dionne, Jean-Claude. 06356

Laves, F. *See* Bambauer, H. U. 05821

05895 **Lawson, J. E., Jr.; Tryggvason, Eysteinn.** Seismicity maps [abs.]: Earthquake Notes, v. 40, no. 2, p. 12, 1969.

06078 **Leamnson, R. N.; Thomas, Josephus, Jr.; Ehrlinger, H. P., 3d.** A study of the surface areas of particulate microcrystalline silica and silica sand: Illinois Geol. Survey Circ. 444, 12 p., illus., tables, 1969.

Studies by the Brunauer, Emmett, and Teller (BET) method emphasize physical differences in these two similar substances. The silica sand possesses only external surface; its area increases with decreasing particle size, in a predictable relationship based on a model of spheres incorporating an experimentally determined roughness factor. The aggregates of microcrystalline silica are porous and quite permeable to nitrogen gas; measured surface area changes surprisingly little with particle size from 100 μ down to 10μ, but increases as particle diameter decreases below 10 μ. After ultrasonic separation, the dried colloidal residue had a surface area of 16 m^2/g. Data comparing BET surface area with that obtained by air permeametry methods show inadequacy of the latter for use with porous particles. — *from* Authors' abstract

LeGrand, H. E. *See* Stringfield, V. T. 06314

06177 **Leighner, Kurt F.; Irwin, Richard M.** Missouri oil and gas wells of record, 1860-1969: Missouri Div. Geol. Survey and Water Resources [Rept.], 2d ser., v. 44, 5 sheets, scales 1 in. to about 16 mi., and 1 in. to 4 mi., 1969.

Sheet 1 contains for the State of Missouri information on oil and gas wells now producing, dry wells, abandoned wells, status unknown, injection wells, oil and gas shows, and stratigraphic tests. The remaining sheets are maps for the following counties with similar data: Bates, Vernon, St. Charles, and St. Louis Counties; Cass and Jackson Counties; Buchanan, Caldwell, Clay, Clinton, Platte, and Ray Counties; and Andrew, Atchison, DeKalb, Gentry, Holt, Nodaway, and Worth Counties. — MCM

05915 **Leimer, Harold Wayne.** The crystal structure of yugawaralite [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1816B, 1969.

06263 **Leipold, Louis E.; Wood, Fergus J.** (editor; coordinator). The Prince William Sound, Alaska, earthquake of 1964 and aftershocks — V. 2, Research studies, seismology and marine geology, Pts. B-C: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, 350 p., illus., tables, 1969.

The papers in this volume are concerned with the seismological aspects of the 1964 Prince William Sound Earthquake, the mapping of crustal deformation in the Gulf of Alaska, the measurements of wave heights of the ensuing tsunami, and a description of a new regional tsunami warning network for Alaska. — KAF

Leiserson, Lee. *See* Collins, A. Gene. 06080

05705 **LeRoux, E. F.; Jorgensen, D. G.** A system for planning and scheduling water resources studies and construction projects: Ground Water, v. 7, no. 5, p. 16-18, illus., 1969.

A simplification of the two most commonly used methods of network planning and scheduling is ideally suited to the planning and evaluation of both water resources studies and construction projects. The project planning diagrams illustrate the system for scheduling of project activities and the relation of each activity to the others. — Authors' abstract

05720 **Levi-Donati, G. R.** Micro-chondrules [abs.]: Meteoritics, v. 4, no. 3, p. 194-195, 1969.

05852 **Levin, B. Ju.; Simonenko, A. N.** Meteorite radiants and orbits [with Russian abs.], Paper 46 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 552-558, illus., table; discussion, p. 623-624, 1969.

For meteorites not to completely burn up in the atmosphere their geocentric velocities must not exceed approximately 20-22 kmps. The low velocity of meteorites is confirmed by concentration of their visible radiants toward the antapex of the Earth's motion. Orbits calculated by taking the above considerations into account, provide reliable evidence that they come from the asteroid belt, although it is not possible to determine the position of their aphelia. It is sufficient, when showing groupings of meteorite orbits, to compare positions of true radiants for meteorites falling within a short time of each other, i.e. with comparable longitudes of node. Radiants and orbits of a number of meteorites were redetermined, and computational errors in published data were eliminated. Calculations were for assumed velocities of 19, 16, and 13 kmps. — *from* Authors' abstract

05872 **Levin, B. Ju.** Origin of meteorites and planetary cosmogony [with Russian abs.], Paper 3 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 16-29; discussion, p. 60-61, 1969.

Studies of condensation in the protoplanetary cloud have not taken into account the opacity of the cloud due to presence of dust. New evidence has accumulated which confirms the important role of diffusion in solid matter during evolution of meteoritic matter and thermal metamorphism; new arguments support the hypothesis of formation of chondrules *in situ*. It is proposed that iron meteorites measuring up to several meters were formed by diffusion in the solid state, that is, in the same way as metallic inclusions in chondrites. Meteorites which formed the Arizona and other craters were probably not iron bodies tens or hundreds of meters in diameter, but stony bodies with metallic inclusions. — *from* Author's abstract

Lewis, Charles F. *See* Moore, Carleton B. 05832

05875 **Lewis, Jackson E.** *Aparnocondylus* Ross, Lewis, and Scolaro, 1964 (Decapoda: Oxystomata) — A reappraisal: Jour. Paleontology, v. 43, no. 5, p. 1292-1294, 1969.

The grounds for recognizing the late Eocene crab *Aparnocondylus* are reviewed in the light of the recently reported occurrence of complete reversal of asymmetry of chelae on Recent specimens of the genus *Calappa*. The unique representative of *Aparnocondylus* is reinterpreted as a minor propodus regenerated on the right, customarily major, cheliped of a species of *Calappa*, thereby raising to two the number of species of this genus known from the upper Eocene of Florida. — Author's abstract

05910 **Li, Yuan-Hui; Takahashi, Taro; Broecker, Wallace S.** Degree of saturation of $CaCO_3$ in the oceans: Jour. Geophys. Research, v. 74, no. 23, p. 5507-5526, illus., tables, 1969.

The degree of saturation of $CaCO_3$ in the Pacific and Atlantic Oceans has been calculated from measurements of the partial pressure of CO_2 gas and of the total content of dissolved inorganic CO_2. Results indicate that the crossover from supersaturation to undersaturation for $CaCO_3$ occurs at a water depth between 500 and 3,000 m for calcite and at about 300 m for aragonite in the Pacific, and between 4,000 and 5,000 m for calcite and between 1,000 and 2,500 m for aragonite in the North Atlantic Ocean. This difference between the Pacific and Atlantic can be attributed to a difference in amount of CO_2 dissolved in these waters. The marked decrease of $CaCO_3$ content in bottom sediments at water depths greater than 3,500 m in the Pacific and 4,500 m in the Atlantic appears to reflect a transition of the sea water from saturation to undersaturation with respect to calcite. — *from* Authors' abstract

Liebermann, Robert C. *See* Molnar, Peter. 06182

Lindsay, James B. *See* Intermountain Association of Geologists. 06253

Lindstrom, R. M. *See* Marti, K. 05864

Lipschutz, M. E. *See* Jain, A. V. 05828

Lipschutz, Michael E. *See* Jain, Anant V. 05713

06106 **Lister, C. R. B.** Studies of oceanic tectonics utilizing detailed surveying and stratigraphy: Bull. Volcanol., v. 33, no. 1, p. 311-318, illus., 1969.

A program of detailed topographic and magnetic surveying, complemented by heat-flow coring and seismic profiling, is underway to determine the structure and history of the abyssal hills on the seaward side of Cobb Rise, off the coast of Washington and British Columbia. A newly discovered small seamount at lat 47° N., long 132° W., has been intensively surveyed as a nucleus of the future surveyed area. Heat flow near this seamount is somewhat below the oceanic average. The evidence so far suggests horizontal sediment transport and seamount formation by uplift. — DBV

05968 **Liu, Shih-Chi; Jhaveri, Dilip P.** Spectral simulation and earthquake site properties: Am. Soc. Civil Engineers Proc., v. 95, paper 6844, Jour. Eng. Mechanics Div., no. EM5, p. 1145-1168, illus., tables, 1969.

Analytic results are presented of study on site properties and their use in ground-motion prediction and simulation. Spectral simulations of random-type ground motions based on modal contributions are formulated. Linear filters representing ground transfer characteristics of seismic stations are investigated. Single-mode and two-mode stochastic models are developed to permit prediction of random-type ground motions and the induced response statistics of structures. From the viewpoint of stochastic simulation, the autocorrelation function of the power spectral density function derived from the recorded accelerogram can be used to characterize the specific ground motion. By matching the power spectral density function of an existing ground-motion record to that of the appropriate output of a linear single- (or multi-) degree-of-freedom system subject to white noise, the predominant modal ground frequencies and dampings can be determined. — ASCE abstract

Lodding, William. *See* Bowman, James F., 2d. 06115

Lodding, William. *See* Isphording, W. C. 06116

06011 **Longenbaugh, Robert A.; Guymon, Gary L.** Analog of ground water in east-central New Mexico — Discussion [of paper 6435 by H. Boyd Phillips and Harris R. McDonald, 1969]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Irrigation and Drainage Div., no. IR4, p. 639-640, 1969.

The authors' implied belief (ibid., v. 95, no. IR1, p. 27-42, 1969) that analog computers are categorically superior to digital computers is founded on a misunderstanding of the last decade's advances in hydrologic research and practice in the computer industry. References pertaining to the use of digital computer reservoir models are numerous in petroleum and water resources literature; economic savings, reliable solutions, and greater flexibility of input and output are reasons for their use instead of electric analogs. The finite element approach may offer considerable savings in time and flexibility, and improved accuracies over the finite difference technique in simulating ground-water basins. For selected problems the digital computer and active element electric analog have been combined into a hybrid computer which has the advantages of both systems. — GDC

05963 **Lorenz, Philip B.** Surface conductance and electrokinetic properties of kaolinite beds [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 4, p. 223-231, illus., 1969.

In a technique for forming clay beds of uniform porosity between 48 and 62 percent, surface conductance and streaming potential of sodium kaolinite were determined over a range of values. Its zeta potential was about -31 m V at neutral pH and changed sign at pH4; surface conductivity at various pH values was directly proportional to zeta potential and from 12 to over 30 times as large as the calculated electrokinetic surface conductivity. In measurements on kaolinite in acid and calcium forms, the acid clay fitted the experimental correlation found for the sodium series; but calcium clay, with less than one-tenth of the zeta potential of sodium clay at neutral pH, had half its surface conductance. Exchangeable ions on kaolinite appear to be in a con-

densed layer on the surface where their mobility determines surface conductance; hydrogen ion from the solution seems effective in replacing sodium. — *from* Author's abstract

Lorin, J. C. *See* Lal, D. 05860

06153 **Loring, D. H.; Nota, D. J. G.** Mineral dispersal patterns in the Gulf of St. Lawrence [with French and Russian abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 289-305, illus., tables, 1969.

Detrital material from the shield is dispersed south and east to the shorelines of New Brunswick, Prince Edward Island, and Cape Breton; in the southern Gulf, this material is mixed with local Paleozoic material and the shelf contributions are difficult to determine. However, small but significant differences in the chemical composition of the sands clearly depict the dispersal patterns of the shield material on the shelf. Ice carried material to the area and it has been reworked and locally redistributed. Under present conditions, it can be expected that some material is still being added from the shorelines adjacent to the Gulf as well as from other parts of the Gulf, such as from the north shore and Anticosti, by ice rafting. — *from* Authors' abstract

05797 **Loring, Stephen H.; Wood, Albert E.** Deciduous premolars of some North American Tertiary camels (Family Camelidae): Jour. Paleontology, v. 43, no. 5, p. 1199-1209, illus., 1969.

The deciduous premolars of eight genera of North American Tertiary camels and Recent *Lama* and *Camelus* are described and illustrated. The last deciduous premolars were already fully molariform by the middle Oligocene, the earliest described. There is a progressive trend for the molarization to extend forward, but there is never as much molarization as in the related oreodonts (Merycoidodontidae). The posterior milk teeth became molariform in a different manner from the permanent molars, and there is no strict homology between parts, although the same terminology should be used for all molariform teeth. The end stage of evolution of the deciduous premolars is represented in Recent camels, where dP_2 has been lost. — *from* Authors' abstract

06163 **Loughnan, F. C.** Chemical weathering of the silicate minerals: New York, American Elsevier Publishing Co., 154 p., illus., tables, 1969.

Although designed more for graduate students in the fields of sedimentary petrology, clay mineralogy, pedology, and soil engineering, this book should not prove beyond the capabilities of serious undergraduate students who possess a basic knowledge of chemistry and mineralogy. It is emphasized that chemical weathering proceeds by reactions that are subject to the same basic laws of chemical equilibria as are normal chemical reactions. Although data are presented in concise form, there is liberal use of diagrams, tables, and references. Chapter headings are: introduction, structures and properties of some of the primary and secondary minerals involved in weathering reactions, chemistry of weathering, environmental factors influencing chemical weathering, chemical weathering of various rock types, and chemical weathering and soil formation. A glossary and author and subject indexes are appended. — MCM

06076 **Lowrie, Allen; Escowitz, Edward.** (editors). Global ocean floor analysis and research data series — V. 1, Kane 9: Washington, D.C., U.S. Naval Oceanog. Office, 971 p., illus. [1969].

This volume contains data collected aboard USNS *Kane* during its 9th scientific voyage from June 21 to October 28, 1968, in the Atlantic Ocean. The track was from Washington, D.C. to Bermuda to the west African coast and return. Instrumentation on the ship is described briefly. Most of the text (chapters 3-9) is composed of data obtained while the ship was in motion. Each chapter corresponds to a leg of the trip and contains: a list of navigation points; Mercator charts of navigation; sea-floor topography; magnetics; sea surface temperatures and salinities; graphic profiles which are a composite of topography, magnetics, temperatures, salinities, and the like; sweep precision profiles; and seismic profiles. — VSN

06262 **Ludwick, John C.; Henderson, Patricia L.** Particle shape and inference of size from sieving: Sedimentology, v. 11, nos. 3-4, p. 197-235, illus., tables, 1968 [1969].

The effect of shape has been determined experimentally by the probability of passage through each of five woven-wire screens of different mm-sized ellipsoids. These range in shape from T/D = 0.2 to 1.0 and from L/D = 1.125 to 2.625, where T is particle thickness, L is particle length, and D is particle diameter. A mathematical sieving theory is developed and put to use by computer-simulated sieving of idealized samples. A bar-type histogram is a justifiable depiction of near-spheres. Broad, overlapping bell-shaped fraction distributions result from more realistic shape inputs. These are considerably offset from the nominal openings of the limiting screens, and the conventional histogram representation is incongruous. — *from* Authors' summary

06141 **Lustig, Lawrence K.** Quantitative analysis of desert topography, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 45-58, illus., 1969.

The quantitative analysis of desert topography may be a specific landform or regional topographic analysis. The former attempts to develop quantitative form parameters that define the geometry of a given feature and relate it to processes at work. Examples from alluvial fans, headland-bay beaches, barchan dunes, and river meanders are cited. Polynomial equations, logarithmic spirals, ellipses, parabolas and sine curves are the forms involved. Regional analysis defines terrain parameters used to map regions and determine degrees of similarity between areas. This approach to treating desert topography is discussed, an analysis of the Basin and Range province by trend-surface analysis being used as an example. — *from* Author's abstract

Lynch, J. *See* Boyle, R. W. 06313

05689 **Mack, Seymour.** Climatic and tectonic factors affecting water quality in the San Joaquin Valley near Fresno, California: Geol. Soc. America Bull., v. 80, no. 12, p. 2527-2537, illus., table, 1969.

An area along the west side of San Joaquin Valley extending from Los Banos to Kettleman City is underlain by ground water characterized by three chemical zones. Uppermost (to 300 feet) is $CaMg(SO_4)$ type with concentrations of dissolved solids about 3000 ppm; lower (to 600 feet and top of Corcoran Clay Member of Tulare Fm.) Na gradually increases in proportion and concentrations diminish to about 1500 ppm; below Corcoran to nearly 2500 feet, water is increasingly Na_2SO_4 type and concentrations are less than 1000 ppm. In contrast, on the east side of valley, water is dominantly $Ca(HCO_3)_2$ type becoming $Na(HCO_3)$ type with increasing depth; concentrations of solids generally are less than 350 ppm. West side zonation is assigned to local rock sources of minerals (type), and to progressive aridity with climatic change starting about 600,000 years ago. — JHF

Macrae, N. D. *See* Edgar, A. D. 06252

05943 **Majewske, Otto P.** Recognition of invertebrate fossil fragments in rocks and thin sections [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1757B, 1969.

Malde, Harold E. *See* Szabo, Barney J. 06245

06367 **Malloy, Richard J.; Merrill, George F.** Vertical crustal movement of the sea floor associated with the Prince William Sound, Alaska, earthquake, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 327-338, illus., 1969.

In 1965, hydrographic and ocean-bottom-scanning sonar surveys southwest of Montague Island, Alaska, were conducted to identify vertical crustal movement of the sea floor associated with the March 1964, Prince William Sound earthquake. Fresh fault scarps were traced seaward for 19 km. Data was used to prepare a bathymetric map of the uplifted area and, by comparison with pre-earthquake surveys, to construct

profiles and a map showing the amount of sea-floor uplift. Lineaments detected by side-scanning sonar included scarps, strata ridges, and joint patterns. — KAF

06139 **Malone, Stephen D.** Focal determination of microearthquakes using a tripartite seismic array: Earthquake Notes, v. 40, no. 3, p. 31-39, illus., 1969.

This paper presents a focal determination routine developed for use in locating microearthquakes recorded on a small tripartite seismic array. The method uses P-wave arrival times at four stations and the S-P time measured at one station. A solution is obtained for each trio of stations. These solutions can be compared to obtain an indication of the precision of the location. Practical problems such as velocity layering and station corrections, and a number of applications are discussed. The advantage of the method is that it leads directly to improved information about local structure. — Author's abstract

06220 **Mannion, L. E.** The trona deposits of southwest Wyoming, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 195-204, illus., 1969.

The trona is found in the Wilkins Peak Member of the Green River Formation. A nonsaline facies encloses the saline facies. The saline beds are ubiquitous shortite, lesser trona, northupite, pirssonite, gaylussite, and searlesite. There are more than 40 beds of trona up to 40 feet thick underlying an area of as much as 1,000 square miles in extent. The trona could have come from the normal weathering of alkali soils, the ground water serving as the transporting agent to playa-type lakes which evaporate from time to time, allowing the ground water to be drawn to the surface. It was deposited rapidly in an isolated part of Eocene Lake Gosiute. — HRC

Marek, Ladislav. *See* Yochelson, Ellis L. 05785

06099 **Markewicz, Frank J.** Ilmenite deposits of the New Jersey Coastal Plain, Field Trip 6 *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 363-382, illus., tables, 1969.

In the New Jersey Coastal Plain, explored since 1956 for ilmenite sand bodies, high concentrations in residential areas could not compete with real estate; in Medford Lakes area, locally erratic deposition was substantiated. Recent work indicates interesting heavy mineral percentages north of Toms River. Concentrate has been produced since 1962 from a mine near Lakehurst, visited on this field trip. Commercial quantities are in the Cape May, Cohansey, and Kirkwood formations; but in the Pensauken mantle are too locally limited. These formations are described with mineral data. Originally derived from upland Precambrian gneisses and granites, and some from Triassic rocks, heavy minerals were distributed chiefly by the ancestral Delaware River and reworked by the Millstone River. Ilmenite reserves are estimated for an area in excess of 15,000 acres, excluding Medford Lakes. — GDC

Markey, Sanford P. *See* Murphy, Robert C. 06068

05864 **Marti, K.; Shedlovsky, J. P.; Lindstrom, R. M.; Arnold, J. R.; Bhandari, N. G.** Cosmic-ray produced radionuclides and rare gases near the surface of Saint-Séverin meteorite, Paper 22 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 246-266, illus., tables; discussion, p. 348, 1969.

Several radionuclides lighter than Ni, with half-life >2 weeks and rare gas isotopes of He, Ne, Ar, Kr, and Xe were measured in two samples from the amphoterite Saint-Séverin. Concentration of low-energy products Al-26, Na-22, Ne-21, Mn-53 and -54, and Kr-83 are lower than normal for stone meteorites of this size, whereas high-energy products B-10 and Ar-38 (in troilite phase) occur in normal concentrations, suggesting that samples analyzed were in a region where secondary cosmic radiation is only slightly developed. Comparison with calculated production rates indicates a

sample location at about 3-4 cm from the preatmospheric surface. The cosmic-ray exposure age of this meteorite calculated from the nuclide pairs is $(11.2 \pm 1.0) \times 10^8$ yr. The relative spallation mass yields of Kr depend on the energy spectrum of cosmic rays. — *from* Authors' abstract

Martin, Glen L. *See* Foster, Richard L. 06010

06081 **Martin-Kaye, P. H. A.** A summary of the geology of the Lesser Antilles: Overseas Geology and Mineral Resources, v. 10, no. 2, p. 172-206, illus., geol. map, 1969.

The Lesser Antilles consists of two closely related, essentially volcanic arcs. The outer eastern arc, extending from Sombrero to Grenada, formed in early Tertiary. The inner arc, coinciding in part with the older but diverging to the northwest in a number of new islands, is later Miocene and Pliocene, with some volcanic activity continuing to the present. Early Tertiary orogenesis triggered volcanism in the first arc. A series of earth movements in Eocene and Oligocene and the Andean orogeny of late Miocene to early Pliocene affected the eastern Caribbean Tertiary. Disturbances also occurred in Pleistocene. Deformation declines for both episodes of folding when traced northward; widespread dike injection followed by diorite intrusion occurred at the northern end. [Summaries are given of stratigraphy and structures of each island group.] — *from* Author's abstract

Marvin, Ursula B. *See* Allen, Ralph O., Jr. 05736

05702 **Mason, Brian.** The Ladder Creek, Horace, and Tribune meteorites (Greeley County, Kansas): Meteoritics, v. 4, no. 3, p. 240-243, illus., 1969.

The Ladder Creek, Horace No. 1, and Horace No. 2, and Tribune meteorites were found within a comparatively small area of Greeley County, Kansas, between 1937 and 1958. Microscopic examination and analyses of the principal minerals show that Ladder Creek, Horace No. 2, and Tribune are essentially identical in composition and structure; it seems reasonable to conclude they are fragments of a single meteorite, a hypersthene chondrite. Horace No. 1 is essentially different, being a bronzite chondrite, and is evidently a distinct fall. The name Ladder Creek should be used for specimens previously called Horace No. 2 and Tribune, and the name Horace should be used for specimens previously called Horace No. 1. — Author's abstract

Mason, Robert. *See* Anhaeusser, Carl R. 05884

Matalas, N. C. *See* Conover, W. J. 05967

05958 **Mathewson, Christopher C.** Bathymetry of the north insular shelf of Molokai Island, Hawaii, from surveys by the USC and GSS MC ARTHUR: Hawaii Inst. Geophysics Data Rept. 14 (HIG-69-21), 9 p., illus., 1969.

Bathymetric surveys carried out by the U.S. Coast and Geodetic Survey Ship MC ARTHUR show that the north insular shelf of Molokai is a smooth plain, gently dipping seaward, with three slight steps, one occurring between the 30- and 60-ft isobaths, one between the 150- and 180-ft isobaths and one near the 300-ft isobath. The shelf break occurs near the 500-ft isobath. Off East Molokai Volcano the shelf is cut by eleven submarine canyons; along West Molokai the shelf is unbroken except for one canyon. About half of the canyons have bowl-shaped heads; the remainder have V-shaped heads. Generally speaking, the canyons originate about one mile offshore. — Author's abstract

06199 **Matson, Robert E.** The strippable coal fields in eastern Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 219-225, illus., tables, 1969.

The large strippable reserves of subbituminous coal and lignite in eastern Montana are an extremely valuable resource. The advent of large extra high voltage generating plants, the low cost of strippable coal, and unit train transportation has opened up

new markets; hence the coal has become of interest economically. The sulfur content is very low. All of the coal is in the Paleocene Fort Union Formation and the reserves are estimated to exceed 215 billion tons, of which 128 billion is subbituminous coal, and 15 billion tons of this is strippable. — HRC

Matsuda, Hideki. *See* Shima, Masako. 05862

06251 **Matten, L. C.; Banks, H. P.** *Stenokoleos bifidus* sp. n. in the Upper Devonian of New York State: Am. Jour. Botany, v. 56, no. 8, p. 880-891, illus., 1969.

The new petrified axes from New York reveal three orders of branching. A pair of rachides emerges from one side of the stem at each node. Their position alternates at successive nodes. Each rachis bears alternately arranged pinnae. The shape of the xylem strand and the number of protoxylem areas are variable. Traces to the pairs of rachides arise either as two separate strands or as a single strand that is presumed to divide while still within the cortex of the stem. Traces to pinnae are ellipsoid or clepsydroid. Tracheids are scalariform and uni- or biseriate, circular-bordered pitted. Peripheral loops are present in all orders of branches. [Other details are described.] The plant is more closely related to the Mississippian pteridosperms than to coenopterid ferns. — *from* Authors' abstract

Matumoto, Hideteru. *See* Aki, Keiiti. 06269

06270 **Matumoto, Tosimatu; Page, Robert A., Jr.** Microaftershocks following the Alaska earthquake of March 28, 1964 — Determination of hypocenters and crustal velocities in the Kenai Peninsula-Prince William Sound area, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 157-173, illus., table, 1969.

During a 4-day period in July, 1964, a few hundred microshocks were recorded. Most of the 249 microshocks for which hypocenters were determined are interpreted as microaftershocks which occurred in the uplifted tectonic block in the region of Prince William Sound and eastern Kenai Peninsula. Several subcrustal microshocks were located beneath the Cook Inlet lowlands and western Kenai Peninsula; these may represent the usual intermediate-depth activity associated with this region. A smoothed model of crustal velocities applicable to eastern Kenai Peninsula was constructed. The model was characterized by near-surface velocities in the range 5.2 to 5.5 kmps and by a marked increase in velocity to 7.5 kmps at about 30 km depth. — KAF

05861 **Maurette, M.; Thro, P.; Walker, R.; Webbink, R.** Fossil tracks in meteorites and the chemical abundance and energy spectrum of extremely heavy cosmic rays, Paper 25 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 286-315, illus., tables, 1969.

Certain meteorites contain fossil tracks that are produced by slowing down heavy nuclei in the primary cosmic radiation. Calculations are given here of the angular distributions and densities of such tracks as a function of depth and orientation of test samples. Comparison of theoretical results with previous experimental work on Saint-Séverin meteorite shows that the cosmic-ray energy spectrum has not changed appreciably in the last 10^7 yr. An experimental study of cosmic-ray tracks is reported also for Johnstown meteorite. A much higher proportion of longer tracks was found among the group of tracks attributed to particles with $Z>30$ than heretofore reported. Evidence is presented for existence of particles in the range 40-70; one track attributed to a particle with $Z>80$ was found. Results support the long time constancy of the cosmic radiation. — *from* Authors' abstract

Maurette, M. *See* Shirck, J. 05873

Maxwell, J. R. *See* VanHoeven, William. 06129

05955 **Mayhew, George Herbert.** Seismic reflection study of the subsurface structure in western and central Ohio [abs.]: Dissert. Abs. Internat. Sec. B, Sci. and Eng., v. 30, no. 4, p. 1765B, 1969.

05944 **Mayhew, Michael Allen.** Marine geophysical measurements in the Labrador Sea — Relations to Precambrian geology and sea-floor spreading [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1757B, 1969.

Mazor, E. *See* Heymann, D. 05849

05929 **McArthur, David Samuel.** Sand movement in relation to beach topography [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1747B, 1969.

05811 **McAtee, James L., Jr.; Henslee, Walter.** Electron-microscopy of montmorillonite dispersed at various pH: Am. Mineralogist, v. 54, nos. 5-6, p. 869-874, illus., 1969.

Montmorillonite dispersions at pH 1 to 13 have been studied by electron microscopy utilizing the adsorption of the clay on cytochrome c protein film. This method is easy and quick and yields specimens that show the type of particle-particle interaction which is occurring in the clay dispersions. — Authors' abstract

05888 **McBride, Earle F.** Stratigraphy and sedimentology of the Woods Hollow Formation (Middle Ordovician), Trans-Pecos, Texas: Geol. Soc. America Bull., v. 80, no. 11, p. 2287-2301, illus., 1969.

The Woods Hollow Formation is a shale lithosome 400 to 500 feet thick that is part of the Ordovician sequence in the Marathon geosyncline. Estimated percentages of rock types in the formation are 65 percent shale, 16 percent quartz arenite, 15 percent calcarenite and 2 percent each of mudstone and conglomerate. The shale was deposited in a marine basin below surf base, probably in water several hundred feet deep. Quartzarenite and calcarenite beds, most of which are probably turbidites, were probably derived from Llanoria and a flanking carbonate plate to the east. Boulder bearing shale and mudstone lenses, containing clasts as much as 9 feet long, were probably deposited by plastic mass flows carrying clasts derived from an uplifted and eroded shelf of the basin. — *from* Author's abstract

McCloy, J. M. *See* Walker, H. J. 06250

06355 **McCormick, C. D.; Picard, M. Dane.** Stratigraphy of Gartra Formation (Triassic), Uinta Mountain area, Utah and Colorado, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 169-180, illus., 1969.

The Gartra Formation lies unconformably over the Moenkopi Formation on the east and the Ankareh on the west, and interfingers with the purple unit of the Popo Agie above. It is informally divided into three subunits: the lower is conglomeratic, poorly sorted, massive and poorly bedded; the middle is finer-grained sandstone and is trough- and planar- crossbedded; the upper is finer-grained than either and is claystone, siltstone, and fine sandstone. Horizontal and small scale cross stratification are characteristic of the upper subunit. The Gartra was deposited by west-northwest flowing streams on a broad flood plain. Detritus was derived from plutonic, sedimentary, and gneiss-schist terranes on the east and southeast. Gradual decrease in velocity and turbulence account for the fining-upward sequences. — *from* Authors' abstract

05841 **McCrosky, R. E.; Ceplecha, Z.** Photographic networks for fireballs, Paper 50 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 600-612, illus.; discussion, p. 629, 1969.

More than 100 meteors brighter than -9 mag have been photographed by photographic networks in the United States and Czechoslovakia since 1964. Results show

that bright fireballs occur far more frequently than expected, but the meteorite fall rate, as judged by the terminal masses of the meteoroids, is below the most pessimistic estimate. Possibly the true influx rate of meteorites is much smaller than suggested by Hawkins and the majority of fireballs are produced by material completely different from meteorites, or our understanding of physical processes encountered by a high-speed ablating body is fundamentally wrong. The average bulk density for the Prairie Network objects was 0.4 g per cm^3; a similar value was obtained for Pribram fireball but the bulk density of Pribram meteorites is 3.6 g per cm^3. — *from* Authors' abstract

06365 **McCulloh, T. H.** Geologic characteristics of the Dos Cuadras Offshore oil field, Chap. C *in* Geology, petroleum development, and seismicity of the Santa Barbara Channel region, California: U.S. Geol. Survey Prof. Paper 679, p. 29-46, illus., tables, 1969.

Petroleum in the Dos Cuadras Offshore oil field occurs in a sandstone and siltstone sequence in an elongate, doubly plunging, faulted culmination of the Rincon anticlinal trend about 5.5 mi south of Santa Barbara, Calif. The field is unique among known "giant" anticlinal fields in the shallowness of the major reservoirs. The structure, lithology and stratigraphy, physical properties of the formations, and reservoirs and reservoir characteristics are discussed. Problems of seepage and its control are reviewed. The Dos Cuadras field is very similar to the nearby Wilmington field which is noted for extreme surface subsidence following oil withdrawal. The problems of prediction are complex in this area, although the consensus of opinion is that maintenance of pressures through water injection will limit and control subsidence. — VSN

06207 **McDade, L. B.; Starkweather, Jack.** Kelley field, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 153-158, illus., 1969.

Kelley field is a stratigraphic oil accumulation within a porous and permeable point-bar sand body deposited directly upon source rock within an eroded stream channel. The original prospect was delineated by the projection of subsurface geological data along the channel trend. Future studies and exploration along similar trends should lead to the discovery of other accumulations of this type. The reduction of dry-hole risk through the use of cores, dip-meter surveys, and detailed production geology, coupled with an increase in production capacity by improving production techniques and the timely installation of pressure maintainance systems, should increase the profitability of these systems. — Authors' conclusions

05694 **McDougall, Ian.** Potassium-argon ages on lavas of Kohala Volcano, Hawaii: Geol. Soc. America Bull., v. 80, no. 12, p. 2597-2600, table, 1969.

Kohala Mountain is regarded as the oldest volcano on the island of Hawaii. Potassium-argon ages on three lavas of the Hawi Volcanic Series, the youngest sequence of lavas on Kohala, range from 0.14 to 0.20 m.y. and indicate that volcanism ceased in the very late Pleistocene. — Author's abstract

05876 **McDowell, Fred W.; Kulp, J. Laurence.** Potassium-argon dating of the Idaho batholith: Geol. Soc. America Bull., v. 80, no. 11, p. 2379-2382, illus., table, 1969.

Twelve potassium-argon isotopic ages have been determined on a representative suite of petrographic types over the areal extent of the Idaho batholith. It appears that the primary igneous activity was Early Cretaceous (125 m.y.) or earlier and that the most recent thermal event occurred in the upper Eocene. The extent to which new batholithic material was added in the Eocene is not evident. — Authors' abstract

05945 **McDowell, Fred Wallace.** Potassium argon dating of Cordilleran intrusives [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1757B, 1969.

06369 **McFall, Robert L.** River metamorphosis — Discussion [of paper 6352 by S. A. Schumm, 1969]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Hydraulics Div., no. HY6, p. 2190, 1969.

In Schumm's paper (ibid., no. HY1, p. 255-273, 1969; *see* Abstracts of North American Geology, June 1969) no mention was made of the effect that soils of the watershed would have upon river metamorphosis. McFall suggests that watershed soil makeup would have some effect upon degradation and sedimentation within the river channel, especially during periods of high surface runoff; during periods when all flow is derived from ground-water sources, the upland soil makeup would have no effect upon the river banks and bed. —GDC

06297 **McGaw, Richard.** Heat conduction in saturated granular materials, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 114-131, illus., 1969.

Heat conduction in granular materials varies with conductivities and volumetric proportions of the constituents. Thermal conductivities predicted by leading equations that utilize these factors are compared with reported values for quartz sand, glass beads, and lead shot, each saturated with various liquids. Only the equation of deVries and a series/parallel flow proposed by Woodside and Messmer approximate the data over a range of conductivity ratio and porosity. Neither equation, however, is based on a fully rational model. An equation proposed by Kunii and Smith utilizes a better physical model but is weakened by its dependence on the regular packing of spheres. — *from* Author's abstract

06146 **McGinnies, William G.** Arid-lands knowledge gaps and research needs, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 277-287, 1969.

The early tendency was to write off deserts as inhospitable to Man, but currently there is great scientific interest in them. Defining terms and developing communications was the first major problem and much work still remains to solve this problem. Little was known about the soils of arid regions, their classification was sketchy, their chemical, physical and biological makeup not well understood, and the widespread salt-affected soils posed problems uncommon in humid regions. There is a great deal of room for improvement in water management; much could be done if advanced practices which are known were put to use. — *from* Author's abstract

06359 **McGinnies, William G.; Goldman, Bram J.** (editors). Arid lands in perspective, including AAAS papers on water importation into arid lands: Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, 421 p., illus., tables, 1969.

This volume contains thirty-one papers dealing with many of the aspects of the water problem, including 12 papers from the symposium "Water importation into arid lands" sponsored by the A.A.A.S. Those which are geologically pertinent are cited individually. The book is designed to serve those with broad interests in arid lands, and to be useful for the technical as well as the nonspecialized reader. — HRC

McGregor, A. A. *See* Biggs, C. A. 06204

06023 **McIlwaine, W. H.** Operation Maple Mountain — Van Nostrand Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 566, scale 1 in. to 1/4 mi., text, 1969.

All bedrock in Van Nostrand Township is Precambrian; relatively flat-lying Huronian Supergroup sedimentary rocks have been intruded by Nipissing Diabase and late diabase dikes. All Huronian rocks belong to the Cobalt Group, with the Gowganda and Lorrain Formations recognized. Bedding in the Huronian sediments has a gentle regional dip to the west; faulting appears to be in three major directions: NE, N, and NW. Native silver with associated Co-Fe-Ni arsenides in carbonate veins is the main type of mineralization. — MCM

McKee, E. H. *See* Sargent, K. A. 06093

06101 **McKenzie, D. P.; Sclater, J. G.** Heat flow in the eastern Pacific and sea floor spreading: Bull. Volcanol., v. 33, no. 1, p. 101-117, illus., 1969.

A simple model based on the hypothesis of sea-floor spreading can account for the main features of two major high heat flow anomalies in the eastern Pacific; the broad band of high values along the crest of the East Pacific Rise and the large concentration of high values centered on the Galapagos Rift Zone. Using the same model to interpret both the surface shape of the midocean ridges and the heat loss of the entire ridge system, the calculated elevation is found to be comparable, though smaller than, that observed for the ridges and the heat dissipated by crustal production along the axis of the entire ridge system is shown to be approximately 15 percent of the total heat loss through the oceans. — Authors' abstract

McKeown, F. A. *See* Hamilton, R. M. 06059

06315 **McPherson, H. J.; Rannie, W. F.** Geomorphic effects of the May 1967 flood in Graburn watershed, Cypress Hills, Alberta, Canada: Jour. Hydrology, v. 9, no. 3, p. 307-321, illus., tables, 1969.

In May 1967, a flood which was at least a 50 year flood occurred in Graburn watershed in the Alberta Cypress Hills. During the 6 day flood period from May 16th to May 21st, 1,023 tons of sediment were removed in solution, 17,400 tons in suspension, and 28,300 tons as bed load. An average thickness of 0.09 feet of fresh overbank material was deposited by the floodwaters. Gravel, as well as the more normal vertical accretion silt and clay material, was laid down on the floodplain surface. Comparison of the rate of denudation calculated for the flood (0.0013 feet) with other reported rates suggested it is not as high as might be expected for a flood of this magnitude. — Authors' abstract

Medaris, L. Gordon, Jr. *See* Fisher, George W. 05814

05827 **Megrue, G. H.** Distribution and origin of primordial helium, neon, and argon in the Fayetteville and Kapoeta meteorites, Paper 73, *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 922-930, illus., tables; discussion, p. 934-935, 1969.

Primordial He, Ne, and Ar have been extracted from polished sections of Fayetteville and Kapoeta meteorite by laser microprobe and analyzed mass spectrometrically. Gas concentration is extremely variable between different portions of dark phase in the same sample. Maximum concentration is found in fine-grained matrix material. In Fayetteville, fine-grained matrix material within a vein contains He-4 concentration of 10^{-1} - 10^{-2} cm^3/g (stp); the location and concentration of gas are consistent with the saturation level of He-4 in interplanetary dust irradiated by solar wind; He-4/Ne-20 and Ne-20/Ar-36 are inversely correlated which can result only from addition of unfractionated Ne to varying amounts of fractionated Ne. Variations in relative abundances of primordial He, Ne, and Ar within the fine-grained material of Kapoeta is the result of heating. — *from* Author's abstract

05783 **Melin, Robert E.** Uranium deposits in Shirley Basin, Wyoming, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 143-149, illus., 1969.

Uranium deposits in Shirley Basin occur in arkosic sandstone beds of the Eocene Wind River Formation, which ranges from a wedge-out to about 500 feet thick, and consists of light gray, fine-grained to conglomeratic sands less than 100 feet thick, interlayered with green clay silt beds. Deposits consist of disseminations and impregnations of uraninite, calcite, pyrite, and marcasite. Much of the uranium is in crescentic rolls, but important amounts are in tabular bodies near the rolls. Larger ore bodies are distributed along the downdip and lateral periphery of tongues of altered ground. Alteration effects include a color change, and removal of pyrite, calcite, and carbonaceous material. Deposits apparently were formed by migrating reactive ground water solutions that collected uranium, carried it downstream, and concentrated it in emplacements at interfaces between altered and unaltered ground. — *from* Author's abstract

Mellick, Paul J. *See* Anders, Edward. 05853

Melson, William G. *See* Jarosewich, Eugene. 05714

06343 **Mercado, S.** Chemical changes in geothermal well M-20, Cerro Prieto, Mexico: Geol. Soc. America Bull., v. 80, no. 12, p. 2623-2630, illus., table, 1969.

Well M-20, one of a group developed for power, discharges a steam-water mixture at maximum rate of 680 tons/hour, 470 Btu/lb at 16 kg/cm^2 pressure, presently the largest natural steam-well discharge known. Production is from at least four zones, 810 m to 1385 m below surface. In the zones, the ratio Na/K decreases from about 8 to 6 while enthalpy increases from 450 Btu/lb to about 600 Btu/lb. Production from various zones, though they are partly interconnected, can be controlled by varying size of well-head orifice. Cl^{-1} remains close to 10,000 ppm in water from all zones. Well-defined maximums observed in 1,500 m hole (deepest to date) are: discharge pressure 1040 psi, bottom-hole temperature 388°C (730°F), and steam-water discharge rate 680 tons/hour. — JHF

Merrill, George F. *See* Malloy, Richard J. 06367

06062 **Meservey, R.** Topological inconsistency of continental drift on the present-sized Earth: Science, v. 166, no. 3905, p. 609-611, illus., 1969.

Certain continents have in the past moved with respect to each other in a manner clearly implied by sea-floor spreading and other data. However, the resulting collective motion of all the continents was apparently not topologically possible on the present-sized Earth. An expanding Earth might resolve this difficulty. — Author's abstract

05946 **Meshref, Wafik M.** Aeromagnetic study of the regional geology of the western half of the Northern Peninsula of Michigan [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1758B, 1969.

06077 **Meyer, F. W.; Hull, J. E.** Seepage tests in L-D1 Borrow Canal at Lake Okeechobee, Florida: Florida Bur. Geology Inf. Circ. 59, 31 p., illus., table, 1969.

Tests were made along Levee D-1 and the adjacent Levee D-1 borrow canal at the west side of Lake Okeechobee near Moore Haven, Fla., to determine the magnitude of the underseepage from the lake. By relating the ground-water gradients in the vicinity to the amount of pickup in a 3 1/2-mile reach of the L-D1 Canal, it was determined that the underseepage factor is about 0.9 cfs per mile per ft of head between the lake and the canal. The coefficient of transmissiblity of the underlying materials is about 72,000 gpd/ft. The values are important in the design of a pumping station which will remove increased underseepage when the lake is raised several feet. — Authors' abstract

06025 **Meyn, H. D.** Operation Maple Mountain — Marconi Township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 568, scale 1 in. to 1/4 mi., text, 1969.

All rocks exposed in Marconi Township are of Precambrian age; oldest are volcanic which in turn are intruded by granitic rocks. The granitic complex forms the basement and presumably the source rocks of the Huronian Supergroup which unconformably overlie it. Aside from the well developed pegmatite dikes and patches, there are no major structural features in the granitic rocks. Minor uranium mineralization is present in the Mississagi Formation in nearby areas, but geophysical surveys of 1967 yielded no encouraging results. — MCM

06026 **Meyn, H. D.** Operation Maple Mountain — Turner Township and northeast part of DeMorest Township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 569, scale 1 in. to 1/4 mi., text, 1969.

Oldest rocks in Turner, Seagram, DeMorest, and Clary townships are Archean metavolcanics and iron formation, unconformably overlain by Huronian sedimentary rocks: Mississagi, Bruce, Espanola, Serpent, Gowganda, and Lorrain Formations, all intruded by the Nipissing Diabase. A near vertical schistosity is well developed in the Archean metavolcanic schists; bedding in the iron formation also shows steep dips. In the Huronian sediments the major feature is a NW striking, NE dipping monocline. Resources of possible economic interest are a quartz vein with some mineralization, and uranium in the Mississagi Formation. — MCM

06027 **Meyn, H. D.** Operation Maple Mountain — Seagram Township and northwest part of Clary Township, District of Sudbury: Ontario Dept. Mines Prelim. Geol. Map P. 570, scale 1 in. to 1/4 mi., text, 1969.

Geological notes for Seagram and Clary Townships are included on Map P. 569; for abstract, see Meyn, this issue. — MCM

Mihailov, G. *See* Boyle, R. W. 06313

Miller, Ernest H. *See* French, Bevan M. 05752

06202 **Miller, Marvin R.** Water resources of eastern Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 237-243, illus., 1969.

Toward the east, in the plains area, wherever permeable sandstone beds, especially Tertiary or Cretaceous, lie at or near the surface, they yield small to moderate quantities of ground water locally. Most of the deeper water is strongly mineralized. Scattered evidence suggests that some of the deeper water, especially that from the Madison Formation, may be demineralized and so be useful. Currently, unconsolidated alluvial fill along the major rivers is beginning to be utilized. Greater precipitation and runoff in the western areas provide large quantities of surface water which is used mostly for irrigation. — HRC

05722 **Millman, Peter M.** The effects of observational errors on the determination of meteorite orbits [abs.]: Meteoritics, v. 4, no. 3, p. 197-198, 1969.

05854 **Millman, Peter M.** (editor). Meteorite research — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag and Dordrecht, Holland, D. Reidel Publishing Co. (Astrophysics and Space Sci. Libr., V. 12), 940 p., illus., tables, 1969.

This symposium was organized and hosted by the International Atomic Energy Agency, aided by six cooperating and cosponsoring international organizations. Subjects discussed included computer-assisted study of meteorite orbit statistics; problems of composition and classification; shock evidence; cosmic-ray effects; ages since formation, fragmentation, and falling to Earth; theories of origin; nature of original solar nebula; parent bodies, and metamorphic processes. The proceedings include 73 papers, 61 of which are cited separately. — VSN

06332 **Millman, Peter M.** Astronomical information on meteorite orbits, Paper 45 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 541-551, illus., tables; discussion, p. 623, 1969.

Orbits of meteorites can be determined only through analysis of data relating to the associated fireballs — geographic latitude and longitude, time and date, radiant elevation and azimuth, velocity relative to Earth. Since observational data from the casual observer must be relied upon, information is normally of low accuracy. With computer programming, a multiple-trial system can be used to derive the best mean value from widely divergent original observations and to demonstrate groups of orbits which result from arbitrary choices of orbital elements. Data available for fireballs from which meteorites have been recovered are analyzed and normal ranges of values of orbital elements derived. Orbits tend to have small semi-major axes, moderate eccentricities, low inclinations. Their closest dynamic association is with the small asteroids with orbits penetrating the zone between Mars and Venus. — *from* Author's abstract

06112 **Minard, James P.; Rhodehamel, Edward C.** Quaternary geology of part of northern New Jersey and the Trenton area, Field Trip 3 *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 279-313, illus., table, 1969.

The Quaternary geology of New Jersey is varied and complex. Deposits of Quaternary age can be divided into two broad classes; glacial deposits of the northern glaciated part of the State, and fluviatile and marine deposits of the unglaciated southern part of the State. Both regions are briefly discussed, however the Trenton area and the northwest part of the State are emphasized. Moraines recently mapped by the senior author in Sussex County are discussed. Deposits in the Trenton area are mapped and described as lithostratigraphic units. Previously these deposits were mapped according to altitude and inferred age. The road log and stop descriptions include examples of typical landforms and internal structures of end moraines, kames, outwash, deltas, natural levees, and channel deposits. —Authors' abstract

05899 **Misra, S. B.** Late Precambrian(?) fossils from southeastern Newfoundland: Geol. Soc. America Bull., v. 80, no. 11, p. 2133-2139, illus., 1969.

Fossils of the Precambrian Conception Group in the Biscay Bay-Cape Race area are found as hundreds of imprints on top surfaces of graded beds. The imprints are grouped into four categories: spindle-shaped, leaf-shaped, round lobate, and dendrite-like. The fossils are believed to be imprints of soft-bodied Metazoans (Coelenterates) represented by Polyps as well as Medusae. The Polyps may have affinity to Pennatulid corals or may represent new forms of colonial Hydrozoans. The fossil-bearing rocks are regarded as Precambrian in age based on lithologic correlation. — *from* Author's abstract

06003 **Mitchell, Andrew H.; Reading, Harold G.** Continental margins, geosynclines, and ocean floor spreading: Jour. Geology, v. 77, no. 6, p. 629-646, illus., tables, 1969.

On Atlantic-type continental margins there is no differential movement between ocean floor and continent. On Andean-type margins spreading ocean floor descends beneath a submarine trench and continental mountain arc, and on island arc-type margins ocean floor descends beneath a trench and island arc bordering a small ocean basin of Japan Sea type. Modern geosynclines of each type have distinct associations of sediments and volcanics. Geosynclines of Mediterranean type occur in small ocean basins between continents. Development of the types of continental margin and associated geosynclines, and changes in type of geosyncline, are related to the oscillation of continents between ocean rises. The sequence preflysch→flysch→molasse in many ancient geosynclines can be interpreted in terms of modern geosynclinal deposits and continental margins. — *from* Authors' abstract

06294 **Mitchell, James K.** Temperature effects on the engineering properties and behavior of soils, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 9-28, illus., 1969.

This is a summary of fourteen papers given in a symposium. Collectively they provide concepts and data that make possible a greatly improved understanding of the importance of thermal influences in soil mechanics and thermal treatment of soils for property improvement. In this report the most significant aspects of each of the contributed papers are summarized and appraised, relevant supplementary data and analyses are introduced as appropriate for illustration of points under discussion, and questions are raised concerning areas needing further study. — *from* Author's abstract

05804 **Mockford, Edward L.** Fossil insects of the order Psocoptera from Tertiary amber of Chiapas, Mexico: Jour. Paleontology, v. 43, no. 5, p. 1267-1273, illus., 1969.

Fourteen specimens of Psocoptera have been found in the late Oligocene to early Miocene amber of the Simojovel area, Chiapas, Mexico. Ten species are included, five of which are described as new and are named as follows: *Belaphotroctes similis* (Family Liposcelidae), *Amphientomum* (*Paleoseopsis*) *elongatum* (Family Amphientomidae), *Epipsocus clarus* (Family Epipsocidae), *Trichopsocus maculosus* (Family Trichopsocidae), and *Archipsocus* (*Archipsocopsis*) *antiguus* (Family Archipsocidae). This sample suggests little change in the psocid fauna of southern Mexico from mid-Tertiary to modern times. — Author's abstract

06302 **Moh, Gunter H.** The tin-sulfur system and related minerals [with German summ.]: Neues Jahrb. Mineralogie Abh., v. 111, no. 3, p. 227-263, illus., tables, 1969.

The tin-sulfur system was studied by quenching, high-temperature X-ray powder diffraction, and differential thermal analysis experiments using rigid silica tubes as reaction vessels; thus a vapor phase was inherent in all experiments. SnS, Sn_2S_3, and SnS_2 were synthesized. The phases present at different temperatures are described. Two new minerals, ottemannite (Sn_2S_3) and nerndtite (SnS_2) are described from various localities, and their X-ray powder diffraction patterns and optical properties are presented. [Address given at Carnegie Institution Geophysical Laboratory, Washington, D.C.] — DBV

06182 **Molnar, Peter; Savino, John; Sykes, Lynn R.; Liebermann, Robert C.; Hade, George; Pomeroy, Paul W.** Small earthquakes and explosions in western North America recorded by new high gain, long period seismographs: Nature, v. 224, no. 5226, p. 1268-1273, illus., table, 1969.

Pronounced differences are found in the amplitude spectrums of surface waves from small earthquakes and underground nuclear explosions in western North America, as recorded by new high gain long-period instruments at $\Delta > 30°$. For earthquakes and explosions having comparable surface wave magnitude, the amplitudes at the longer periods (40-60 sec) are consistently much larger for earthquakes than for explosions. It is possible to separate the earthquake and explosion populations on the basis of the spectral ratio of Rayleigh waves and amplitudes of Love and Rayleigh waves for events of comparable m_b. These conclusions are based on data for events in the magnitude range $m_b > 5$, but the differences observed may persist even for events of $m_b < 5$. — DBV

06210 **Montana Geological Society.** Eastern Montana symposium — The economic geology of eastern Montana and adjacent areas, 20th annual conference, 1969: Billings, Mont., Montana Geol. Soc., 256 p., illus., tables, 1969.

This symposium, dedicated to Richard L. Larson, contains eleven papers (nine cited separately) dealing with regional petroleum reservoirs, five on the areal geology of various areas, three on stratigraphic topics, five on nonhydrocarbon mineral resources, and two special papers on drilling techniques and petroleum economics. A correlation chart of Beltian to Pleistocene rocks for eastern Montana and a summary of Montana and North Dakota producing oil fields are included. — HRC

06211 **Montana Geological Society.** Richard L. Larson (1929-1969), *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 3, portrait, 1969.

Moore, C. B. *See* Nava, D. F. 05724

Moore, C. B. *See* Beaulieu, P. L. 05738

05832 **Moore, Carleton B.; Lewis, Charles F.; Nava, David.** Superior analyses of iron meteorites, Paper 60 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 738-748, illus., table; discussion, p. 839, 1969.

New analyses are reported of 100 iron meteorites for Ni, Co, P, C, S, and Cu. Meteorites were sampled using a new milling technique which provided chipped samples; replicate analyses of high precision were made on splits. Graphic methods, based on the new results, were used to evaluate earlier analyses of iron meteorites. Abundance of P, C, and S show variations depending upon concentrations of nonmetallic mineral phases taken in the sampling procedure. Co and Ni show positive correlation with each other. Approximately 35 percent of analyses before 1907, as reported by Farrington, may be classified as 'superior' and suitable for use today; more recent analyses are of higher superiority. Within selected gallium-germanium groups direct relations may be predicted between Co, Ni, and P. — *from* Authors' abstract

05769 **Moore, J. M., Jr.; Best, Myron G.** Sillimanite from two contact aureoles: Am. Mineralogist, v. 54, nos. 5-6, p. 975-979, illus., table, 1969.

"Fibrolite" from two contact aureoles is proved by X-ray diffraction to be sillimanite; mullite in such occurrences now seems unlikely. — Authors' abstract

Moore, John G. *See* Fry, Gary F. 06311

06090 **Moore, Walter L.; Karner, Frank R.** Magnetic anomalies in Pembina County, North Dakota: North Dakota Geol. Survey Rept. Inv. 49, 7 p., illus., 1969.

Difficulties using magnetic compasses in northeastern North Dakota led to an investigation of two troublesome areas in west-central Pembina County. Near Hensel the Earth's magnetic field was 11,500 gammas in excess and near Akra 7,500 gammas in excess of the usual field of 60,000 gammas. The question of whether the anomalies are due to ore bodies of economic value or to some other magnetic material can be answered only by sampling, which means drilling to depths ranging from 900 to 1,350 feet from the surface to the deposit, if one presumes the deposit top is coincident with the upper contact of the basement. The anomalies may be due to hematite bodies, magnetite disseminated in gabbros or similar rocks, or magnetite-rich bodies of igneous or replacement origin. — MCM

06161 **Morgan, J. W.; Ehmann, W. D.** Multiparameter coincidence spectrometry applied to the non-destructive neutron activation analysis of meteorites: Anal. Letters, v. 2, no. 10, p. 537-545, illus., tables, 1969.

A nondestructive method for the neutron activation analysis of chondritic meteorites by multiparameter coincidence spectrometry is described. Results for sodium, cobalt, nickel and iridium are presented, and agree with single coincidence spectrometry measurements. Scandium photopeaks are prominent in the multiparameter spectrum and this element could also be determined. The advantages of multiparameter spectrometry over single coincidence counting are outlined. — Authors' abstract

05988 **Morgan, Vincent; Erd, Richard C.** Minerals of the Kramer borate district, California, Pt. 1: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 9, p. 143-153, illus., tables, 1969; Pt. 2, ibid., no. 10, p. 165-172, illus., 1969.

Most of the more than 80 minerals found here are described, and 13 are illustrated. Ulexite is described in more detail and five photographs showing different forms are included. — ESL

05822 **Morimoto, Nobuo; Tokonami, Masayasu.** Domain structure of pigeonite and clinoenstatite: Am. Mineralogist, v. 54, nos. 5-6, p. 725-740, illus., tables, 1969.

Single crystals from different environments have been examined by X-ray photographic and diffractometer methods. The reflections of h + k odd are diffuse compared with those with h + k even for crystals from volcanic rocks, while all reflections are sharp for crystals from plutonic rocks. Measurements of spreading of diffuse reflections with h + k odd suggest that spreading is closely related to composition and thermal history of the specimens. Diffuse reflections are explained by a domain structure with an antiphase relation in which each domain is columnar along the *c* axis and has a shift of (a + b)/2 from the contiguous ones. The domain structure of pigeonite is considered to be produced by rapid growth of a number of nuclei of pigeonite in a high-temperature phase with monoclinic symmetry. Clinoenstatite is considered to have changed from protoenstatite of orthorhombic symmetry. — *from* Authors' abstract

06069 **Morimoto, Nobuo; Akimoto, Syun-iti; Koto, Kichiro; Tokonami, Masayasu.** Modified spinel, beta-manganous orthogermanate — Stability and crystal structure: Science, v. 165, no. 3893, p. 586-588, illus., tables, 1969.

A new high-pressure polymorph with a modified spinel structure, β-Mn_2GeO_4 is stable in a pressure range intermediate between the field of the polymorph with the olivine structure and that of another high-pressure polymorph. Oxygen atoms are located approximately in cubic close packing with manganese and germanium atoms in octahedral and tetrahedral interstices, respectively, as in the spinel structure; however, germanium atoms form Ge_2O_7 groups instead of isolated GeO_4 groups. — Authors' abstract

06174 **Morozumi, M.; Chow, Tsaihwa J.; Patterson, C.** Chemical concentrations of pollutant lead aerosols, terrestrial dusts and sea salts in Greenland and Antarctic snow strata: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1247-1294, illus., tables, 1969.

It is found that lead concentrations increase from <0.001 micrograms Pb per kg ice at 800 B.C. to >0.200 micrograms Pb per kg ice today in north polar ice sheets and that the levels of lead in south polar ice sheets are generally below detection limits before 1940 and rise only to about 0.020 micrograms Pb per kg ice after 1940. Ten times more dust was found in Greenland interior ice than in Antarctic interior ice, but twice as much sea salt was found in Antarctic interior ice than in Greenland interior ice. The proportions of Na, Cl, Mg, Ca, and K adhered closely to sea-salt ratios in ices that were relatively free of silicate dusts. Possible explanations for these observations are advanced. — GV

Morris, D. B. *See* Nelson, P. H. 05909

Morrison, Donald A. *See* Greenwood, William R. 05711

Morton, Robert B. *See* Irwin, James H. 06259

06322 **Mose, Douglas.** The age of the Hatton Tuff of the Ouachita Mountains, southeastern Oklahoma: Geol. Soc. America Bull., v. 80, no. 11, p. 2372-2378, illus., table, 1969.

The Hatton Tuff and the Chickasaw Creek Tuff occur near the bottom and the top, respectively, of the Stanley Shale. Seven whole-rock samples of the Hatton Tuff and four whole-rock samples of the Chickasaw Creek Tuff were analyzed for their Rb and Sr isotopic content. Analysis of the Hatton Tuff yielded an isochron age of 310 ± 15 m.y. ($\lambda_{Rb-87} = 1.39 \times 10^{-11}$ yr). —*from* Author's abstract

Mottana, A. *See* Edgar, A. D. 06252

05699 **Moulder, E. A.; Jenkins, C. T.** Analog-digital models of stream-aquifer systems: Ground Water, v. 7, no. 5, p. 19-24, illus., 1969.

The best features of analog and digital computers were combined to make a management model of a stream-aquifer system. The analog model provides a means for synthesizing, verifying, and summarizing aquifer properties; the digital model permits rapid calculation of the effects of water-management practices. Given specific management alternatives, a digital program can be written that will optimize operation plans of stream-aquifer systems. The techniques are demonstrated by application to a study of the Arkansas River valley in southeastern Colorado. — Authors' abstract

05912 **Mountjoy, E. W.; Chamney, T. P.** Lower Cretaceous (Albian) of the Yukon — Stratigraphy and foraminiferal subdivisions, Snake and Peel Rivers: Canada Geol. Survey Paper 68-26, 71 p., illus., tables, geol. map, 1969.

Those strata that form part of Peel Plain are subdivided into three new formations: Trevor, 1200 feet of sandstone, equivalent to the upper three-fourths of the Arctic Red, and gradationally overlying it in the southern part of the area; Arctic Red, 2000 feet of shale divisible into five members; and Martin House, including all shale and siltstones above Devonian or Carboniferous and beneath the Arctic Red. Nine biostratigraphic subdivisions of the Albian are established from assemblages of

Foraminifera. Most significant are two late Middle Albian and one Early Albian assemblages representing the strongest marine environments, correlatable over most of the sedimentary basins, and referable to the Jolie Fou and Clearwater Seas, respectively. Each provides a datum from which remaining depositional intervals of the Albian stage can be interpreted. — *from* Authors' abstract

05998 **Moussa, Mounir T.** Quebrada de los Cedros, southwestern Puerto Rico, and its bearing on some aspects of karst development: Jour. Geology, v. 77, no. 6, p. 714-720, illus., 1969.

The gorge of Quebrada de los Cedros (a tributary of Rio Macana in southwestern Puerto Rico) is a deroofed portion of a complex cavern system through which part of the drainage of Rio Tallaboa was diverted by a process of subterranean stream piracy. The direction of the underground flow in the upper part of the *quebrada* is against the direction of the dip of the beds, which indicates that the structural control was not critical in the development of the subterranean passageways. — *from* Author's abstract

05723 **Mueller, G.** Comparison of redistribution of volatiles within the parent bodies of chondrites and within the Earth's crust [abs.]: Meteoritics, v. 4, no. 3, p. 198-199, 1969.

05857 **Mueller, G.** Genetical interrelations between ureilites and carbonaceous chondrites, Paper 42 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 505-517, illus., tables; discussion, p. 535-537, 1969.

Petrologic and mineralogic studies indicate that ureilites are not achondrites, but have been formed through effects of shock and heating on grape-bunch and globular types of chondrules which in turn are characteristic of Type II and III carbonacous chondrites. Heating above the melting point of clinoenstatite results in Type I ureilites, and above the melting point of olivine, Type II ureilites. The shock effect may have been from collision of two parent bodies, impact of meteorites on the surface of a parent asteroid, or volcanic activity on a parent body. The ratio of carbonaceous chondrites to ureilites is about 10 to 1. The higher percentage of shock effects in carbonaceous chondrites than in ordinary chondrites supports Mueller's hypothesis (1953) that material of these stones occupied zones in the parent closer to its surface than material of ordinary chondrites. — VSN

Mueller, Paul A. *See* Condie, Kent C. 06045

06222 **Mullens, Thomas E.** Stratigraphy of lower Echo Canyon, northern Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 213-218, illus., 1969.

A summary of the history of stratigraphic ideas concerning the red conglomerate formations is followed by brief descriptions of the units and the current interpretations. The lower Echo Canyon Formation, Cretaceous in age, is 3,100 feet thick near the mouth of the canyon but thins to an edge about ten miles away under an unconformity, and is poorly sorted conglomerate in a muddy matrix but includes sandstone and mudstone. The Evanston Formation of Cretaceous and Paleocene age overlies this, is 0 to 1,200 feet thick, and has two units: a basal conglomerate and an upper reddish-tan clastic unit. The overlying Wasatch Formation of Paleocene and Eocene age is mainly interbedded conglomerate and light-colored conglomeratic sandstone, and unconformably overlies all the older units in the range. — HRC

06336 **Müller, H. W.; Zähringer, J.** Rare gases in stony meteorites, Paper 67 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 845-856, illus., tables; discussion, p. 931, 1969.

Light rare gases were analyzed in 13 meteorites not previously studied. Seventeen meteorites have been reanalyzed. Heavy rare gases were measured in 25 cases. The U/He-4 age of the achondrite Angra dos Reis (stone) is at least 2.5 times higher than its K/Ar age. Inheritance of primordial rare gas of any known type is insufficient to explain the result. The H-chondrite Phum Sambo contains light primordial rare gases. The heavier primordial rare gases show unusually high concentration in the L-chondrites Barratta and Hedjaz. The hypersthene Zavid is depleted in Xe-131 by 10 percent. The bronzite chondrite Ouallen has an unusually high fission-Xe component. — Authors' abstract

05806 **Munoz, J. L.; Eugster, H. P.** Experimental control of fluorine reactions in hydrothermal systems: Am. Mineralogist, v. 54, nos. 5-6, p. 943-959, illus., tables, 1969.

The solid polyphase buffer technique is adapted to permit quantitative study of synthetic fluorine-bearing hydrothermal systems. Three buffer reactions are discussed, and calculated gas fugacities for eight typical buffering systems tabulated. Equilibrium between fluorine buffer and charge was investigated using phlogopite as starting material because it shows solid solution for which both end members are readily obtained. Using these, composition of phlogopite solid solution in equilibrium with a fluorine buffer at a fixed temperature can be approached from both sides. Data obtained is too incomplete to warrant definte conslusions but the 700°C isotherm illustrates a significant point. Correlation between gas and phlogopite composition was calculated and distribution of fluorine between mica and gas shown to be very asymmetric, mica removing fluorine nearly quantitatively. — ESL

06256 **Murdock, J. Neil.** Geology of Flaming Gorge Dam and reservoir, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 22-31, illus., 1969.

The damsite is in a canyon cut in the Uinta Quartzite of Precambrian age, and the reservoir is backed up over rocks of varying ages through and including Cenozoic. Details of the dam and some of the geological problems encountered during its construction are given. Shale zones interlayered in the quartzite and other formations constitute one of the major problems, serving as slide planes in the gently-dipping rocks lubricated by the water in the reservoir. Concrete protective walls are used as counter measures; grouting is used to close joints in the foundation rocks. — HRC

05928 **Murphy, Kenneth Robert.** An investigation of rubidium concentrations in fresh water reaches of the Hudson River [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1728B, 1969.

06068 **Murphy, Robert C.; Djuricic, Milica V.; Markey, Sanford P.; Biemann, K.** Acidic components of Green River shale identified by a gas chromatography-mass spectrometry-computer system: Science, v. 165, no. 3894, p. 695-697, illus., table, 1969.

A system consisting of a gas chromatograph coupled to a mass spectrometer and computer has been used to characterize the extractable acidic components of Green River shale. This system accumulates mass spectra at every point of the gas chromatogram in a permanent form which permits one to observe mass spectra of minor as well as major constituents. One minor component, whose identification was confirmed by synthesis, was 6,10,14-trimethylpentadecanoic acid. — Authors' abstract

05683 **Murray, Grover E.** Some economics of academics: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2252-2255, 1969.

The petroleum industry's future rests with minds well trained in the diverse fields of technology that range from exploration to hydrocarbons' many uses. The industry at present is getting professional personnel at bargain rates, which figure out to 1 1/2 cents per share of a large company's common stock. Industry's contribution to educational costs, however, is disproportionately small to its gain, and its contribution of 31/100th of 1 percent of profits (in 1966) to educational institutions is not enough in either financial support or involvement. — *from* Author's abstract

06168 **Murtaugh, J. C.; Currie, K. L.** A preliminary study of Manicouagan structure, Saguenay County: Quebec Dept. Nat. Resources Prelim. Rept. 583, 9 p., geol. map, 1969.

The Manicouagan structure, a polygonal depression filled with unusual rocks, could be either an extensively reworked impact scar, or an aberrant igneous complex. Much of the outcrop shown on the map is now submerged by a reservoir. The hinterland is underlain by Precambrian, cut by narrow curvilinear belts of fracturing. Just inside the marginal canyon is a lowland underlain by disturbed Precambrian and Ordovician. An annular plateau composed of near horizontal layers of igneous rocks rises several hundred feet above the lowland. A second lowland lies between this plateau and the central mountain. Petrology of the igneous and metamorphic map units is examined in some detail. This structure belongs to that equant group displaying both igneous and shock metamorphism phenomena. — ESL

Murthy, V. Rama. *See* Griffin, W. L. 06044

06124 **Muter, Richard B.; Cockrell, C. F.** The analysis of sodium, potassium, calcium, and magnesium in siliceous coal ash and related materials by atomic absorption spectroscopy: Appl. Spectroscopy, v. 23, no. 5, p. 493-496, illus., tables, 1969.

A method for the analysis of sodium, potassium, calcium, and magnesium in siliceous coal ash and related materials by atomic spectroscopy is presented. The method involves the dissolution of all complex silicates present in coal ash after fusing with lithium tetraborate flux. Working curves utilizing standards composed of complex silicates are shown to be more accurate than the common water standards. The use of lithium tetraborate as a flux should also allow the method to be extended to permit the analysis of all major constituents of coal ash. — Authors' abstract

05880 **Mutschler, Felix E.; Larson, Edwin E.** Paleomagnetism as an aid to age classification of mafic intrusives in Colorado: Geol. Soc. America Bull., v. 80, no. 11, p. 2359-2367, illus., tables, 1969.

Differences in remanent magnetization directions from oriented samples, after partial ac demagnetization, offer a means of differentiating mafic igneous rocks of (1) late Precambrian (1400 to 1300 m.y.), (2) early Paleozoic (600 to 450 m.y.), and (3) late Cretaceous to Holocene (<75 m.y.) age in the eastern Rocky Mountains of Colorado. — *from* Authors' abstract

05885 **Naeser, C. W.; Dodge, F. C. W.** Fission-track ages of accessory minerals from granitic rocks of the central Sierra Nevada batholith, California: Geol. Soc. America Bull., v. 80, no. 11, p. 2201-2211, illus., tables, 1969.

Ages of 44 apatites, 54 to 128 m.y.; 34 sphenes, 71 to 118 m.y.; 2 allanites, 86 and 87 ± 9 m.y.; 3 epidotes, two 84 ± 8 m.y. and one 140 ± 14 m.y.; and one garnet, 114 ± 11 m.y. from plutonic rocks of the central Sierra Nevada and Inyo Mountains have been determined by the fission-track method. Ages generally increase from east to west. All sphenes are as old as, or older than, coexisting apatites. Hornblende K-Ar ages appear to be the most insensitive to heat, apatite fission-track ages, the least, and biotite K-Ar and sphene fission-track ages fall between the two extremes and show the closest concordance of all pairs. — AG

06305 **Naeser, C. W.** Etching fission tracks in zircons: Science, v. 165, no. 3891, p. 388, illus., table, 1969.

A new technique has been developed whereby fission tracks can be etched in zircon with a solution of sodium hydroxide at 220°C. Etching time varied between 15 minutes and 5 hours. Colored zircon required less etching time than the colorless varieties. — Author's abstract

05979 **Namowitz, Samuel N.; Stone, Donald B.** Teacher's guide for *Earth science — The world we live in*, 4th edition: New York, American Book Co., 675 p., illus., 1969.

The purpose of this guide is to provide the teacher with suggestions on scheduling and presentation of subject matter, to give brief answers to general questions of the text, and to provide a directory of sources of earth science teaching aids, including films and filmstrips. The guide material of 88 pages precedes the 4th edition of the text by Namowitz, wherein are references and suggestions for the teacher. — MCM

05947 **Namy, Jerome Nicholas.** Stratigraphy of the Marble Falls Group, southeast Burnet County, Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1758B, 1969.

05724 **Nava, D. F.; Moore, C. B.** Zinc groupings of iron meteorites [abs.]: Meteoritics, v. 4, no. 3, p. 199-200, 1969.

Nava, David. *See* Moore, Carleton B. 05832

06140 **Neal, James T.** Playa variation, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 13-44, illus., tables, 1969.

Playa is the general term used to describe generally barren depressions, or lowest portions of desert basins, that periodically collect runoff and sediments; they occur in all of the major arid zones of the Earth. There is a varying nomenclature from one arid region to the next, and few of the terms are correlative, largely because of regional variations in the playas. The similarities of surface properties suggest that standardized *playa surface descriptors* should be used that relate to physical and environmental properties in the basins. When these descriptors are combined with topographic, hydrologic, geologic, and climatologic information, an adequate understanding and developmental history of an individual playa can be gained. — *from* Author's abstract

Neil, Forrest C. *See* Papadopulos, Istavros S. 05704

Nelen, Joseph. *See* Fredriksson, Kurt. 05868

05909 **Nelson, P. H.; Morris, D. B.** Theoretical response of a time-domain, airborne, electromagnetic system: Geophysics, v. 34, no. 5, p. 729-738, illus., 1969.

The secondary magnetic field induced by a time-domain, airborne EM system is calculated by transforming the tabulated mutual impedances of two magnetic dipoles above an Earth of homogeneous or layered resistivity structure. The computational procedure is extended to produce response curves useful in interpreting data from a particular system, the Barringer Input system. It is demonstrated that the apparent resistivity can be estimated through use of the receiver channel ratios, a method which is independent of absolute system calibration. Layered earth calculations indicate to what extent conductive overburden cases can be readily distinguished, in terms of the conductivity-thickness parameter, but separate interpretation of layer resistivity and thickness will require an amplitude-calibrated flight system. — Authors' abstract

Newell, M. F. *See* Rankin, D. W. 06064

06290 **Noble, Calvin A.; Demirel, Turgut.** Effect of temperature on strength behavior of cohesive soil, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 204-219, illus., tables, 1969.

The objective of this study was to characterize the behavior [of two cohesive soils] in terms of more fundamental parameters than is current general practice. A simple model for soil based on bonds at interparticle contacts and an equation for rate of deformation of a stressed soil mass are proposed and shown to be consistent with observed soil behavior. The same model and equation were found to apply to soil behavior in both direct shear and creep tests. The study was conducted on remolded, statically compacted specimens of a highly plastic clay and a low-plasticity silt using a direct shear machine modified to permit control of specimen temperature and for use

as a controlled stress apparatus as well as controlled rate of deformation. — *from* Authors' abstract

05924 **Noble, Clyde S.** Investigation of the inert gas content of Hawaiian inclusions that exhibit anomalous ages [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1539B, 1969.

Nokleberg, W. J. *See* Wise, W. S. 05813

Nordemann, D. *See* Cantelaube, Y. 05830

06340 **Norris, Stanley E.** The ground-water situation in Ohio: Ground Water, v. 7, no. 5, p. 25-33, illus., 1969.

Present ground-water use in Ohio, about 650 mgd, is 5 percent of water entering ground-water reservoirs. Largest aquifers are in glacial sand and in major stream valleys, glacial outwash of upland areas and the buried Teays Valley system, limestone and dolomite in western Ohio, and sandstone and shale in the eastern half. More of the increasing water demand will be met from ground-water sources by developing supplies at many new sites, and increased pumpage by drilling of additional wells and artificially recharging aquifers at present heavily-pumped sites. Large quantities of ground water in storage, virtually unexploited, could be used for temporary low-flow augmentation of streams. Management of resources are needed to help solve supply and demand problems and to resolve conflicts between users. Among future problems will be those arising from underground disposal of wastes. — *from* Author's abstract

Nota, D. J. G. *See* Loring, D. H. 06153

Nowroozi, Ali. *See* Auld, Bruce. 06033

06338 **Nyquist, L. E.; Begemann, F.; Huneke, J. C.; Signer, P.** Short exposure ages of meteorites determined from the spallogenic $^{36}Ar/^{38}Ar$ ratios, Paper 69 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 875-866, illus., tables; discussion, p. 933, 1969.

Assuming that the effective radiation flux has remained constant during irradiation, a meteorite exposure age may be calculated from spallogenic Ar-36/Ar-38 ratio. Since this ratio approaches an equilibrium value, the method is practicable only for irradiation times less than about 5 m.y. The isotopic composition of argon in samples of the metallic phase of 6 chondrite and 1 iron meteorite was determined mass spectrometrically. Chondrites investigated and exposure ages determined are: Ladder Creek, <2 m.y.; Beenham, 1.8 m.y.; Ramsdorf, 3.1 m.y.; Ness County (1894), 3.6 m.y.; Tabor, 4.4 m.y.; Saint Séverin > 6 m.y. A lower limit of 5 m.y. was obtained for the exposure age of the iron meteorite Pitts. Ages are in satisfactory agreement with ages determined by other methods. — *from* Authors' abstract

Nyquist, L. E. *See* Schultz, L. 06339

06127 **Oakes, Malcolm C.** Hugh Dinsmore Miser, 1884-1969: Oklahoma Geology Notes, v. 29, no. 5, p. 129-130, portrait, 1969.

06248 **Oleson, Ole B.; Reeh, Niels.** Preliminary report on glacier observations in Nordvestfjord, East Greenland: Gronlands Geol. Undersogelse Rap. 21, p. 41-53, illus., tables, 1969.

The unexpectedly low calf production (10 km^3/yr) from Daugaard-Jensen glacier was the most interesting observation. Although part of a very productive group of glaciers, it is far from being comparable to Jakobshavn Isbrae which has a calf production of about three times as much. The apparent periodicity of calf production in Daugaard-Jensen glacier is also emphasized. — *from* Authors' conclusions

06279 **O'Neil, James R.; Taylor, Hugh P., Jr.** Oxygen isotope equilibrium between muscovite and water: Jour. Geophys. Research, v. 74, no. 25, p. 6012-6022, illus., tables, 1969.

Oxygen isotopes have been equilibrated between muscovite and aqueous alkali chloride solution and between paragonite and alkali chloride solution in the temperature range of 400-650°C at 1 and 1.5 kb fluid pressure. It is found that the direct relationship between cation and oxygen isotope exchange suggests that some type of solution-redeposition mechanism operated during muscovite-paragonite transformations in aqueous solutions. Also, the extensive oxygen isotope exchange with the solution that accompanies the formation of muscovite from kaolinite implies a breakdown of the kaolinite structure. It is noted that data from this study can be combined with the results of other laboratory equilibration studies to establish a set of calibrated oxygen isotope geothermometers. — GV

05798 **Ormiston, Allen R.** The trilobite *Koneprusia* in the Lower Devonian of Alaska: Jour. Paleontology, v. 43, no. 5, p. 1210-1212, illus., 1969.

A well-preserved pygidium of *Koneprusia* sp. is described [from a portion, probably late Emsian in age, of the type section of the McCann Hill Chert, in the Nation-Tatonduk Rivers area of east-central Alaska] to document its presence in the Alaskan Devonian and to revise the known geographic distribution of this rare genus. — Author's abstract

05858 **Oró, J.; Gelpi, E.** Gas-chromatographic mass-spectrometric studies on the isoprenoids and other isomeric alkanes in meteorites, Paper 43 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 518-523; discussion, p. 537, 1969.

A detailed study of a number of hydrocarbons observed in gas chromatographic analyses of six carbonaceous chondrites has resulted in identification of nine homologous series of isomeric alkanes in addition to the normal alkane series. Two show isoprenoid structures corresponding to 2, 6, 10, 6-trimethyl and 2, 6, 10, 14-tetramethyl alkanes. Individual members in each of the two series cover the ranges C_{14}-C_{19} and C_{19}-C_{21}, respectively. The rest is made up of five series of monomethyl alkanes and two of monocycloalkanes. The presence of a member of the n-parrafin series between C_{11} and C_{21} inclusive was confirmed. Hydrocarbon content ranged from 6.7-82.8 ppm. An identical study of graphite-troilite nodules of three iron meteorites yielded qualitatively similar results. Isoprenoids are present in all meteoritic samples analyzed. — *from* Authors' abstract

06344 **Orr, Phil C.** *Felis trumani*, a new radiocarbon dated cat skull from Crypt Cave, Nevada: Santa Barbara Mus. Nat. History Dept. Geology Bull. 2, 8 p., illus., tables, 1969.

Description of a new species of Mountain Lion, *Felis trumani*, from Lahontan lake sediments in Crypt Cave, Nevada, radiocarbon dated at 19,750 ± 650 yr BP, together with comparison and measurements of two extinct cats from Rancho La Brea, and the modern Mountain Lion, *F. trumani* is characterized by the extremely short and broad skull, and the backward slant of the jaws. — Author's abstract

06257 **Osmond, John C.** Geologic hazards in the Uinta Mountains area, Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 33-40, illus., 1969.

A brief survey of the hazards in the region indicates that the Uinta Mountains are not a seismic hazard area; no earthquakes have been reported. Natural landslides, however, are common, and these, along with slumps, solifluction, and unstable talus are the chief hazards. The combination of structures, stratigraphy, topography, and climate all conspire to make landslides and related phenomena common. Numerous manmade landslides are also known; the Hoytsville slide and those in the Park City area are specifically cited as examples. Natural and manmade floods (from spilling

reservoirs) are also common. A map shows the areas where these phenomena are known. — HRC

Ottemann, Joachim. *See* ElGoresy, Ahmed. 05708

Otto, J. B. *See* Denison, R. E. 06126

05879 **Otvos, Ervin G., Jr.** A subrecent ridge complex in southeastern Louisiana: Geol. Soc. America Bull., v. 80, no. 11, p. 2353-2357, illus., 1969.

Formation of the Moreau-Caminada chenier plain on the Louisiana coast started about 3,000 years ago. Autochthonous and detrital peat derived from pre-existing marsh deposits is interlayered in the beach ridges. After chenier progradation ceased Mississippi delta lobe sediments surrounded the chenier plain. Later much of the plain was eroded and the littoral drift direction reversed. — *from* Author's abstract

05980 **Overman, Michael.** Water — Solutions to a problem of supply and demand: Garden City, N.Y., Doubleday and Co. (Doubleday Sci. Ser.), 192 p., illus., 1969.

Facts and problems of the present potential world water crisis are presented in non-technical language and suggestions are made for preventing the potential crisis from becoming a reality. Chapter headings are: toward a crisis, water budget, measuring water, irrigation and dams, hydroelectricity, desalination, purifying water, and future water resources (making of rain, watering of deserts, rerouting of rivers, and fresh-water stores in the sea). — MCM

05725 **Oversby, Virginia M.** Determination of lead isotope compositions in iron meteorites by the double spike technique [abs.]: Meteoritics, v. 4, no. 3, p. 201, 1969.

05920 **Oweis, Issa Sebeitan.** A solution of nonlinear plane strain problems in dynamic soil mechanics [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1673B, 1969.

06291 **Paaswell, Robert E.** Transient temperature influences on soil behavior, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 220-230, illus., tables, 1969.

The temperature profiles developed in soil samples for conditions of transient temperature changes at one boundary surface are examined. Tests in the laboratory indicate that establishment of temperature profiles enables correlation to be made between surface temperature changes and moisture changes on a transient basis. Where surface boundary conditions can be accurately modeled, heat conduction theory, assuming sample homogeneity, can be used to predict these temperature profiles. — *from* Author's abstract

Paduana, Joseph A. *See* Post, James L. 06292

06030 **Page, Robert.** The Fairweather fault ten years after the southeast Alaska earthquake of 1958: Seismol. Soc. America Bull., v. 59, no. 5, p. 1927-1936, illus., 1969.

Field observations made 10 years after the southeast Alaska earthquake of July 1958, reveal environmental and geomorphic changes in the Fairweather fault zone. Faulting associated with the earthquake killed many trees in the Crillon Lake region. Trees were tilted and later fell, and possibly were drowned because of changes in drainage conditions. A nearly vertical, 2-meter scarp in soil has been eroded to a slope of 35° to 40° in the decade since 1958. Microearthquake activity sampled at a single site on the fault is at least equal to or greater than that reported from active sites on the San Andreas and Denali faults. The distribution of S-P times is consistent with a uniform planar distribution of shocks on a segment of the fault that slipped in 1958. The expected seismicity from aftershocks of the 1958 earthquake is less, but not significantly less, than the observed seismicity. — Author's abstract

Page, Robert A., Jr. *See* Matumoto, Tosimatu. 06270

06323 **Pageau, Yvon.** Nouvelle faune ichthyologique du dévonien moyen dans les Grés de Gaspé (Québec) — [Pt.] 2, Morphologie et systématique — Sec. 2, Arthrodires: Dolichothoraci [with English abs.]: Naturaliste Canadien, v. 96, no. 5, p. 805-889, illus., tables, 1969.

In the concluding paper on a new fish fauna from the Gaspé Sandstone (Pageau, Pt. 1, ibid., v. 95, no. 6, 1968; Pt. 2, Sec. 1, ibid., no. 3, 1969), six new genera and species of Arthrodira, all placed in the order Dolichothoraci, are described from new fossiliferous horizons of the early Middle Devonian Battery Point Formation (younger of two Gaspé Sandstone formations) at several localities on Gaspé Bay. New taxa, represented by cranial roofs or by isolated plates of the cephalic and thoracic shields, are: *Batteraspis fulgens*, *Laurentaspis splendida*, *Kolpaspis beaudryi*, *Cartieraspis nigra*, *Gaspeaspis cassivii*, *Quebecaspis russelli*. In a study of numerous specimens of *Phlyctaenaspis acadica* (Whiteaves), a dolichothoracan from Gaspé Sandstone at Compbellton, New Brunswick, *P. atholi* n. sp., is distinguished; neither species has been found at Gaspé Bay. — VMJ

06047 **Pakiser, L. C.; Eaton, J. P.; Healy, J. H.; Raleigh, C. B.** Earthquake prediction and control: Science, v. 166, no. 3912, p. 1467-1474, illus., 1969.

Long range forecasting (about a year) of approximate locations and magnitudes of earthquakes, based on observed changes in rates of vertical and horizontal motions and on seismic activity in fault zones, is attainable in the near future. Short range prediction (hours or days) might be achieved through continuous monitoring of ground tilt, strain, seismic activity, and possibly fluctuations in the geomagnetic field. Earthquakes can be artificially triggered by fluid injection, impounding of water in reservoirs, and underground nuclear explosions; thus, it may be possible to induce steady creep or periodic release of strain energy along faults to inhibit accumulation sufficient to produce a disastrous earthquake. Current knowledge of processes involved in generation of earthquakes is not yet sufficient to guide an earthquake control program. — DBV

06162 **Palmer, Arthur N.** Geospeleology of Massachusetts, *in* Caves of Massachusetts (by Peter M. Hauer): Altoona, Pa., A Spence Production, p. 4-6, illus., 1969.

True cave development in Massachusetts is limited to a narrow belt of carbonate rocks in the Berkshire Valley. Mechanical forces have created fissures and talus caves throughout the state, but the marble, limestone, and dolomite of the Berkshires provide the only regions where large-scale solution can take place. Because most of the lowlands in the valley are either covered by glacial debris or do not have sufficient relief for subsurface diversion of streams or free drainage by ground water, the most favorable areas are the foothills or lower slopes of mountains which rise out of the valley, such as Greylock or Monument Mountain. Folding and faulting of the carbonates limit the exposed areas to narrow bands surrounded by insoluble rocks. Examples are given of the typical sequences in cave development to be found. — GDC

05978 **Palmquist, Robert C.** The configuration of the Prairie du Chien-St. Peter contact in southwestern Wisconsin — An example of an integrated geological-geophysical study: Jour. Geology, v. 77, no. 6, p. 694-702, illus., 1969.

Geologic and gravity data suggest that the irregular upper surface of the Prairie du Chien Formation is characterized by well-integrated linear topographic features that probably reflect ancient drainage systems. — ETR

05789 **Pampe, William R.** Late Devonian fish remains from central Colorado: Jour. Paleontology, v. 43, no. 5, p. 1111-1113, illus., 1969.

The Devonian System of western and central Colorado consists of a lower clastic unit, comprising the McCracken, Elbert, and Parting Formations, and an upper carbonate unit, the Dyer and Ouray Formations. Antiarchan and crossopterygian fragments here described as *Bothriolepis* sp. cf. *B. coloradensis* and *Holoptychius* sp. cf. *H. giganteus* were found in the Parting Formation at Spring Gulch, Fremont County,

Colo. Fish remains, the only fossils found in the Elbert and Parting Formations, have been reported from several localities in Colorado and Wyoming and are considered to be Frasnian in age. — *from* Author's abstract

05896 **Panamá Admin. Recursos Minerales.** Mapa geológico—Area 65, Cerro Petaquilla, Donoso, Panamá (Proyecto Minero de Azuero): Panamá Admin. Recursos Minerales Mapa 5, scale 1:15,000, 1969.

05704 **Papadopulos, Istavros S.; Larsen, William R.; Neil, Forrest C.** Ground-water studies—Chicagoland Deep Tunnel System: Ground Water, v. 7, no. 5, p. 3-15, illus., tables, 1969.

Elements of the Deep Tunnel System (flood and pollution control for Chicago region's combined sewer areas) of main concern to ground-water resources are conveyance tunnels and mined storage reservoir for conveying and storing polluted storm-water overflows. Silurian and Cambrian-Ordovician aquifers will be protected from deleterious effects by ensuring that a positive hydraulic head, causing an inward flow, is continuously maintained around the tunnels and the mined reservoir; in the latter aquifer this necessitates that ground-water levels are maintained by artificial recharge. Results of extensive ground-water studies indicate the proposed aquifer protection is feasible, recharge requirements will vary from 1.4 mgd in 1976 to 6.0 mgd in 2010, and seepage into the tunnels will be small, in amounts easily controlled. — *from* Authors' abstract

Papanastassiou, D. A. *See* Wasserburg, G. J. 05908

05962 **Papke, Keith G.** Montmorillonite deposits in Nevada [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 4, p. 211-222, illus., table, 1969.

Nevada's montmorillonite production has been mostly natural adsorbent clay from the Ash Meadows district. In studies of 30 deposits, hosts are pyroclastic and other volcanic rocks. Deposits are believed formed in four ways: eleven by alteration of volcanic ash soon after settling in playa lake basins; two by deposition of fine-grained clastics; eleven by hydrothermal alteration of various rock types; six by partial ground-water alteration of glassy rhyolites. The exchange cation is more commonly sodium than calcium or magnesium. In all except the saponitic Ash Meadows deposits montmorillonite is the predominant clay mineral; kaolinite and illite are in one-fifth of the samples; chlorite or mixed layers are rare. Some montmorillonite from incompletely altered pyroclastics can be wet separated to yield a light-colored 2μ fraction with superior viscosity and thixotropy. — *from* Author's abstract

Parker, Ronald B. *See* Society of Economic Geologists. 05775

Parrillo, D. G. *See* Depman, A. J. 06375

05805 **Parris, David C.; Green, Morton.** *Dinohyus* (Mammalia: Entelodontidae) in the Sharps Formation, South Dakota: Jour. Paleontology, v. 43, no. 5, p. 1277-1279, illus., table, 1969.

The anterior portion of a skull is referred to *Dinohyus*. The specimen is compared to *Pelonax lemleyi* Macdonald of Whitneyan age and *Dinohyus hollandi* Peterson of late Arikareean age. The specimen is the first entelodont [artiodactyl] to be reported from the [Miocene] Sharps Formation. It was found in a sandstone stream channel within the Sharps Formation [in Badlands National Monument] from which a microfaunule was recovered. The microfaunal assemblage is similar to the Godsell Ranch Faunule and includes [the zapodid rodent] *Plesiosminthus*, which is recorded from the Sharps Formation for the first time. — Authors' abstract

Patterson, C. *See* Morozumi, M. 06174

Pawson, David L. *See* Donnay, Gabrielle. 06055

06145 **Paylore, Patricia.** Bibliographical sources for arid lands research, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 247-275, 1969.

This is an annotated bibliography of sources for arid land research, with much more than geological information included. There are 370 entries and an index. — HRC

05767 **Peacor, Donald R.** Triphylite-sarcopside-graftonite intergrowths from Custer, South Dakota: Am. Mineralogist, v. 54, nos. 5-6, p. 969-972, illus., 1969.

Sarcopside occurs as crosscutting sets of laths, oriented approximately parallel to {112} of triphylite at the Bull Moose Quarry, Custer, South Dakota. The textural relations indicate an origin through exsolution and in this respect the material is similar to graftonite-sarcopside and graftonite-triphylite intergrowths. Graftonite-sarcopside intergrowths are also found at the Bull Moose Quarry, as well as specimens showing the expected coexistence of all three phases. — Author's abstract

Pearson, Eugene F. *See* Zenger, Donald H. 06192

Pearson, Robert C. *See* Doe, Bruce R. 05687

Pellas, P. *See* Cantelaube, Y. 05830

Pellas, P. *See* Lal, D. 05860

06277 **Pessagno, Emile A., Jr.** Upper Cretaceous stratigraphy of the western Gulf Coast area of Mexico, Texas, and Arkansas: Geol. Soc. America Mem. 111, 139 p., illus., 1969.

Planktonic foraminifera are one of the most important groups of pelagic invertebrates for precise local, regional, and intercontinental correlation. In this study they were utilized to subdivide the Upper Cretaceous of the western Gulf Coast into six biostratigraphic units. This system of zonation is based on association of diagnostic taxa at given horizons, range zones and concurrent range zones of various taxa, relative abundance of important taxa at various horizons, and phylogeny and evolution of Upper Cretaceous planktonic foraminifera. This system of zonation was established by analysis of more than 1,000 samples; creation of the regional correlation chart was a byproduct. The biostratigraphy of each section of the Coastal Plain is discussed in detail. An appendix gives the location and description of microfossil localities. — ESL

05956 **Peterson, Donald Neil.** Glaciological investigations on the Casement Glacier, southeast Alaska [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1765B-1766B, 1969.

Peterson, Jon R. *See* Tilgner, Edward E. 06241

06376 **Pfeiffer, John E.** The emergence of Man: New York and London, Harper and Row, 477 p., illus., 1969.

A growing interest in prehistory among people concerned with today's social and political problems, educators, and social scientists as well as laymen indicates that findings about life in prehistoric times bear on problems in neurophysiology, psychology and psychiatry, animal behavior, and architecture; research along these lines, in turn, bears on problems in archeology and anthropology. Of the 22 chapters in this book, those on primate origins, first member. of the family of Man, "southern apes", and fossils and tools as clues to Man's beginnings, are most relevant to geology and paleontology. — MCM

Phillips, Evan R. *See* Ransom, D. M. 05772

Philpotts, John A. *See* Schnetzler, Charles C. 06329

Pialli, G. *See* Baldanza, B. 06335

05671 **Picard, M. Dane; Hulen, J. B.** Parting lineation in siltstone: Geol. Soc. America Bull., v. 80, no. 12, p. 2631-2636, illus., table, 1969.

By testing the orientation of parting lineation in fine to medium siltstone of the Red Peak Formation in Wyoming against the orientation of assymetric ripple marks, the parting lineation was found to be an equally good indicator of current direction. It was further found that the fabric of grain long axes in siltstone is anisotropic, parallel with the surface expression of parting lineation, and essentially the same in opaque and nonopaque grains. — RGY

05681 **Picard, M. Dane; Aadland, Rolf; High, Lee R., Jr.** Correlation and stratigraphy of Triassic Red Peak and Thaynes Formations, western Wyoming and adjacent Idaho: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2274-2289, illus., tables, 1969.

Stratigraphic correlations of the Triassic Thaynes Formation of eastern Idaho and the Red Peak and Crow Mountain Formations of Wyoming have been uncertain. The Alcova Limestone, a marker bed in the Wyoming sequence, is a marine tongue extending eastward from the upper part of the Thaynes. Red Peak-Thaynes correlations permit reconstruction of a generalized paleogeography. In eastern Idaho and westernmost Wyoming, carbonate mounds and oolite shoals lined the shelf edge. Restricted, shallow-marine conditions extended eastward from the banks into western Wyoming. Throughout west-central and central Wyoming, shallow-marine and paralic conditions prevailed during deposition of most of the Red Peak. The similarity of these rocks to those of west Texas suggests the possibility of oil and gas accumulations along the shelf edge. — *from* Authors' abstract

Picard, M. Dane. *See* High, Lee R., Jr. 06227

Picard, M. Dane. *See* McCormick, C. D. 06355

06318 **Pinder, George F.; Bredehoeft, John D.; Cooper, Hilton H., Jr.** Determination of aquifer diffusivity from aquifer response to fluctuations in river stage: Water Resources Research, v. 5, no. 4, p. 850-855, illus., 1969.

The diffusivity of a homogeneous isotropic aquifer can be determined from the response in the aquifer to fluctuations in river stage. Observed changes in head in the aquifer are compared with theoretic head values computed assuming a series of diffusivities. These values are generated by approximating the stage hydrograph as a series of discrete steps and summing the influence of each increment. The diffusivity of the aquifer is calculated from the best-fitting theoretical response curve. Diffusivities computed for an aquifer at Musquodoboit Harbour, Nova Scotia, agree with values determined from pumping test and digital model analysis. — Authors' abstract

05971 **Piper, David Z.; Goles, Gordon G.** Determination of trace elements in seawater by neutron activation analysis: Anal. Chim. Acta, v. 47, no. 3, p. 560-563, illus., tables, 1969.

In all the methods by which trace elements have been measured in the past, it was necessary to perform a rather sophisticated chemical separation and enrichment of elements of interest before analysis. In the method described, abundances of several trace elements can be determined directly and simultaneously in dried sea salt by neutron activation analysis. — ESL

05766 **Pittman, Edward D.** Twin laws and composition of plagioclase feldspar in tuffs: Am. Mineralogist, v. 54, nos. 5-6, p. 963-965, illus., table, 1969.

Universal stage measurements of 105 plagioclase crystals from seven tuffs in the western United States show that twin laws with the (010) composition plane constitute 94.3 percent. The composition range of the plagioclase is from An_{10} to An_{37} with 54 percent in the An_{24-28} interval. Most of the plagioclase has high-optics; a few crystals display transitional optics. — Author's abstract

Plant, A. G. *See* Douglas, J. A. V. 05747

Pochtarev, V. I. *See* Guskova, E. G. 05843

Pomeroy, Paul W. *See* Molnar, Peter. 06182

06206 **Poole, Lafayette E.; Starkweather, Jack.** Hiawatha field, Musselshell County, Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 145-150, illus., 1969.

Hiawatha field demonstrates that the primary trapping mechanism in the Tyler sands is the variation in the distribution of individual sand bodies, with some structural modification. The productive point-bar Tyler sands were deposited within a paleoriver channel cut into the petroliferous Mississippian Heath limestone and shale. This paleoriver channel is adequately defined across central Montana and further subsurface exploration should find additional Tyler oil. — Authors' conclusions

06292 **Post, James L.; Paduana, Joseph A.** Soil stabilization by incipient fusion, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 243-253, illus., tables, 1969.

A procedure is given for determination of the melt range of soil-additive mixtures using the phase equilibria approach, thus making possible the choice of a fluxing agent. The investigation includes the melt-temperature range of soils with respect to their composition, an analysis of soils representative of the various oxide combinations found in soil types comprising the surface of the Earth, and thermal stabilization of the soil. Mineralogy and oxide combinations of common soil types of the world are considered, and a list of representative soils is presented together with the soil mineral contents. — *from* Authors' abstract

Potter, Paul Edwin. *See* Scheidegger, Adrian E. 06261

06132 **Powell, Benjamin N.** Petrology and chemistry of mesosiderites — [Pt.] 1, Textures and composition of nickel-iron: Geochim. et Cosmochim. Acta, v. 33, no. 7, p. 789-810, illus., tables, 1969.

Metal-silicate textures in 10 mesosiderites indicate that metal structures formed in place, after the presently observed physical relationships were established. The Widmanstätten structure is observed only occasionally in mesosiderites. More often kamacite nucleation appears to have been influenced by grain boundaries, resulting in irregular structures. Characteristic features of the metal are the high Ni contents of the centers of taenite masses and a general absence of plessite. Electron microprobe analyses reveal that taenite and kamacite masses in mesosiderites show distinct composition-dimension correlations related to cooling rate in the temperature range 500-350°C. The cooling rate determined for nine mesosiderites was 0.1°C per 6 m.y. — KAF

05692 **Powell, C. McA.** Intrusive sandstone dykes in the Siamo Slate near Negaunee, Michigan: Geol. Soc. America Bull., v. 80, no. 12, p. 2585-2594, illus., 1969.

Sandstone dikes transect the bedding and are parallel to the cleavage in the Siamo Slate of the Marquette synclinorium. These dikes, common in the slates, are composed of fine-grained sandstones and contain a higher proportion of iron-rich carbonate than the host rocks. The cleavage in both the slates and the interbedded sandstones is produced by parallel orientation of thin pelitic foliae. Individual cleavage foliae can be traced from one pelitic layer, through a sandy lamination and into the next pelitic layer. Microstructures in disrupted sandy laminations indicate that the sandstone dikes formed at the same time as the cleavage. Both the cleavage foliae and dikes are interpreted as having formed by intrusion accompanying tectonic dewatering of the Siamo Slate during late diagenesis or very low-grade metamorphism. — *from* Author's abstract

05877 **Pratt, Richard M.; Schlee, John.** Glaciation on the continental margin off New England: Geol. Soc. America Bull., v. 80, no. 11, p. 2335-2341, illus., 1969.

The maximum limit of last glaciation off New England was probably along an irregular line extending through Nantucket Shoals, across Great South Channel, northern Georges Bank, and at least to edge of Scotian Shelf. If glaciers lowered sea level about 130 m, the ice margin was probably subaerial on Nantucket Shoals and Georges Bank, and was bordered by outwash and meltwater channels leading away from ice front. On Scotian Shelf, the margin may have bordered directly on the ocean. Glaciofluvial nature of original deposits and marine reworking during eustatic rise in sea level have made it difficult to recognize ice-contact deposits near the limit of maximum glacial advance. Gravel on shallow banks and ledges is in bimodal mixture with sand. Association of coarse gravel and sand suggests post-depositional reworking of till by marine processes and removal of silt and clay. — HCW

Price, P. B. *See* Fleischer, R. L. 05749

06028 **Pyke, D. R.** Adams Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 571, scale 1 in. to 1/4 mi., text, 1969.

Most of Adams Township is underlain by medium- to coarse-grained, massive, pink granodiorite which is fairly uniform in composition averaging about 20 percent quartz and 6 percent hornblende, now partly altered to biotite and epidote. The northeastern section is underlain predominately by metavolcanics and serpentinized and carbonized ultramafic rocks. Pleistocene and Holocene deposits cover all but one to two percent of the area. Resources of possible economic interest are magnesite, gold, and nickel. — MCM

06029 **Pyke, D. R.** Eldorado Township, District of Timiskaming: Ontario Dept. Mines Prelim. Geol. Map P. 572, scale 1 in. to 1/4 mi., text, 1969.

Archean volcanic rocks and associated irregular sill-like intrusions of ultramafic and subordinate mafic rocks underlie a large portion of Eldorado Township. Northeast-trending diabase dikes are prevalent and form the backbone of many outcrop areas. Pleistocene and Holocene deposits mantle approximately 95 percent of the area. The main structural feature is a bend in the strike of the foliations from a westerly to a northwesterly direction. Folds are difficult to delineate; major recognized faults trend northwest. Although little detailed exploration work has been done, there are possibilities of economic interest in the sulfide deposits. — MCM

05867 **Quijano-Rico, M.; Wänke, H.** Determination of boron, lithium, and chlorine in meteorites, Paper 13 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 132-145, illus., tables; discussion, p. 152, 1969.

A highly sensitive fluorometric method developed to determine boron with detection limit at the ppb level, and the thermal-neutron activation technique to determine lithium and chlorine in iron and stone meteorites are described. Abundance data determined for about 54 meteorites and for granite and diabase standard samples (G-1, W-1) are tabulated. Comparisons are made with analytical results by other methods. In Canyon Diablo and in Toluca iron 0.02 and 0.03 ppm boron were found, respectively; in chondrites a noticeable correlation was observed between boron content and petrologic groups of Van Schmus and Wood (1967). Boron behaves like other volatile elements in that lower concentrations are found in more recrystallized chondrites. Lithium content is independent of petrologic type. The B/Li ratio of about 7 in carbonaceous chondrites supports chemical fractionation as a cause of depletion of boron. — VSN

Quirk, J. P. *See* Aylmore, L. A. G. 06295

06002 **Ragan, Donal M.** Structures at the base of an ice fall: Jour. Geology, v. 77, no. 6, p. 647-667, illus., 1969.

The ice fall on Gulkana Glacier, Alaska Range, Alaska, is below the firn limit, and major and minor structures are exposed well enough to allow interpretations of relationships between flow and structural evolution of the ice that, by analogy, can be applied to similar processes in rocks. Foliation and other structures develop at the base

of the fall; their evolution downstream and formation of additional structures can be studied in detail. The dominant role of shear in formation of these structures demonstrates that foliation is a shear phenomenon. Formation and deformation of foliation and associated structures is interpreted to be the principal process by which differential flow of the mass is accomplished. — DRM

Rajan, R. S. *See* Lal, D. 05860

Raleigh, C. B. *See* Pakiser, L. C. 06047

06186 **Ralston, Dale R.** Ground-water development in Idaho, 1968: Idaho Dept. Reclamation Water Inf. Bull. 10, 24 p., illus., tables, 1969.

Ground-water development in Idaho increased in activity in 1968 with 55 percent more applications approved to appropriate ground water and 70 percent more wells reported drilled than in 1967. Important areas of development were in the Boise River area, south Snake Plain areas, Aberdeen-Springfield, Minidoka-Jerome, Wood River, Salmon Falls Creek, Mountain Home, and Payette River. Development in 1969 will be centered in southern Idaho, in the same general pattern as in 1968. Southwest Idaho will undergo even greater increase in well development as the urban influence continues. Agricultural growth will be influenced by decisions concerning desert land entries and general availability of surface water. As in 1968, the most important new large well developments should occur on or near the Snake Plain. — *from* Author's conclusions

06187 **Ralston, Dale R.; Chapman, Sheri L.** Water-level changes in the Mud Lake area, Idaho, 1958-68: Idaho Dept. Reclamation Water Inf. Bull. 7, 29 p., illus., table, 1969.

Water levels beneath most of the Mud Lake area are within 100 feet of land surface. Depth-to-water is greater than 200 feet in the extreme northern, western, and southern portions; depth of 100 feet or less, common to most of the area, is above preliminary estimate of reasonable pumping level. Contours of water-level elevation delineate upper, intermediate, and lower zones — upper and lower have gradients of about 2 and 10 feet per mile, intermediate of 20 feet per mile. Ground-water levels have not changed significantly during the period 1958-68. Present well development has not altered greatly the ground-water resource, indicating additional well development can occur without causing widespread decline. Specific areas may show local declines and rises as recharge varies in magnitude and location. — *from* Authors' summary

06064 **Rankin, D. W.; Stern, T. W.; Reed, J. C., Jr.; Newell, M. F.** Zircon ages of felsic volcanic rocks in the upper Precambrian of the Blue Ridge Appalachian Mountains: Science, v. 166, no. 3906, p. 741-744, illus., table, 1969.

Five zircon samples from Pennsylvania, Virginia, and North Carolina yield discordant uranium-lead ages which suggest an original age of 820 m.y. and an episodic lead loss at 240 m.y. The indicated age of lead loss is interpreted as the age of movement of the Blue Ridge thrust sheet. — Authors' abstract

Rannie, W. F. *See* McPherson, H. J. 06315

05772 **Ransom, D. M.; Phillips, Evan R.** The proportionality of quartz in myrmekite — A reply [to 1969 discussion by D. Shelley of 1968 paper by Phillips and Ransom]: Am. Mineralogist, v. 54, nos. 5-6, p. 984-987, 1969.

The authors' method (ibid., v. 53, p. 1411-1413, 1968) in measuring the amount of quartz in myrmekite was based on measurement of a planar surface of the quartz and plagioclase. Random selection of gridded squares on random thin-section cuts should provide a reasonable representation of the areal intergrowths considered. The point count method would allow for calculation of statistical error but is of doubtful use otherwise. Work done has led the authors to favor the exsolution theory rather than Shelley's 1964 hypothesis for myrmekite genesis. It may be polygenetic. — ESL

05727 **Rao, A. S. P.** Meteorites throgh space and time [abs.]: Meteoritics, v. 4, no. 3, p. 203-204, 1969.

06053 **Raup, David M.; Seilacher, Adolf.** Fossil foraging behavior — Computer simulation: Science, v. 166, no. 3908, p. 994-995, illus., 1969.

Meander patterns produced by ancient sediment feeders can be simulated by digital computer with x-y plotter output. Change in input constants (with a single program) produces variation comparable to genetically controlled behavioral differences between species and genera. — Authors' abstract

06209 **Rawson, Richard R.** Petrographic analysis of the "Kibbey Limestone", *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 165-177, illus., 1969.

Four sedimentary environments were recognized on the basis of mapping the facies distribution of the Ray Member: basinal, bank margin, bank, and lagoon. Textures of micrites may prove helpful in separating bank environments from basinal environments. The Williston basin during Ray deposition was connected to the Cordilleran trough by way of northern Montana or Canada; central Montana was occupied by a shallow, restricted lagoon. Sedimentation kept up with subsidence during Ray deposition until the late Ray interval when anhydrite was deposited across the top by a regressive sea. The base of the Ray closely approximates a time stratigraphic line. The lack of fauna in the Ray may represent hypersaline conditions. The Ray may serve as a sedimentation model for a shallow, marine to hypersaline, intracratonic basin. — *from* Author's conclusions

Raymond, G. P. *See* Walker, L. K. 05985

05703 **Read, William F.** New specimens from the Faucett, Missouri, meteorite locality: Meteoritics, v. 4, no. 3, p. 244-250, illus., 1969.

In December 1966, Brookins and Twiss (Kansas Acad. Sci. Trans., v. 69, p. 175, 1966) reported the finding of two specimens of an olivine-bronzite chondrite near Faucett, Missouri. Since that date, six additional specimens have been found. Another probable specimen was found but later lost. This paper describes the circumstances of all nine finds and presents a map of the discovery sites. — Author's abstract

Reading, Harold G. *See* Mitchell, Andrew H. 06003

Recchi G. *See* Giudice, D. del. 05774

05728 **Reed, G. W.; Jovanovic, S.** Hg isotopic measurements in chondrites [abs.]: Meteoritics, v. 4, no. 3, p. 204-205, 1969.

Reed, J. C., Jr. *See* Rankin, D. W. 06064

05833 **Reed, S. J. B.** Phosphorus in meteoritic nickel-iron, Paper 61 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 749-762, illus., tables; discussion, p. 839-840, 1969.

This paper describes the results of a survey of 6 chondrites, 1 pallasite and 54 irons, in which the kamacite was analysed for phosphorus and nickel. Correlations with cooling rate, Ga-Ge group and abundance of rhabdite are considered, but it appears that the controlling factors are too complex for clear correlations to be found. The range of phosphorus contents of kamacite in octahedrites is surprisingly large in relation to arguments based on phase equilibrium. It is likely that nonequilibrium considerations are important. Further work will be required to establish cause and effect relationships with respect to phosphorus and cooling rates. — Author's abstract

Reeh, Niels. *See* Oleson, Ole B. 06248

05882 **Reeves, Robert G.** Structural geologic interpretations from radar imagery: Geol. Soc. America Bull., v. 80, no. 11, p. 2159-2164, illus., 1969.

The writer contends that certain structural features may be more readily recognized on side-looking airborne radar (SLAR) images than on conventional aerial photos or ground observations. Radar penetrates haze, dust, most clouds, and some precipitation and vegetation. Reoriented flight runs emphasize features unaccented in other runs of different orientation. Lineaments stand out in areas tested in Nevada and folded rocks cut by faults can be clearly seen on radar imagery in northern Alabama. — *from* Author's abstract

06135 **Remick, Jerome H.** Geology of Harricana-Turgeon area, Abitibi-East and Abitibi-West counties [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 564, 217 p., illus., tables, geol. maps, 1969.

Most of the map-area is underlain by the western end of the Precambrian Chibougamau-Matagami zone of metamorphosed and intrusive rocks, tightly folded and steeply dipping. Mineralization can be divided into three zones: massive to disseminated sulfides, quartz veins, and specularite-magnetite iron-formation. Outcrops are listed and described briefly. Three appendices give summaries of diamond drill core logs, a list of geophysical surveys on file for the map-area, and a list of geological and geochemical maps within the map-area. Six sheets of the geologic map are in pocket. — ESL

06373 **Renard, Kenneth G.** Evaporation from an ephemeral streambed — Discussion [of paper 6368 by M. L. Sorey and W. G. Matlock, 1969]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Hydraulics Div., no. HY6, p. 2200-2204, illus., 1969.

Low evaporation rates presented in this paper (ibid., v. 95, no. HY1, p. 423-438; *see* Abstracts of North American Geology, June 1969) were 2.2 percent of estimated annual groundwater recharge; combined recharge and evaporation in streambeds seem a small part of the total runoff absorbed. In some ephemeral reaches significant transpiration makes 'guestimates' of water-loss evaluation. In broad alluvial streambeds, transmission loss water limits ground-water recharge. Reduction of flows by absorption in channel alluvium is demonstrated in Arizona's Walnut Gulch experimental watershed, climatically similar to the Tucson basin of paper 6368. Tributaries underlain by impervious materials, with surface areas far exceeding main streams, have evaporation losses nearer to 10,000 acre-ft per yr, or 20 percent of estimated groundwater discharge. In water management, land modification to enhance infiltration is desirable. — GDC

05778 **Renfro, A. R.** Uranium deposits in the Lower Cretaceous of the Black Hills, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 87-92, illus., 1969.

The Black Hills have produced about 4 million lb of U_3O_8. All known orebodies are in continental and marginal-marine sandstone of the Lower Cretaceous Inyan Kara Group, and regional environments that affected each formation, indirectly affected related deposits. Deposits are of the roll front type, deposited by down-plunge migrating geochemical cells initiated during Laramide orogeny. Passage through host rocks caused changes that are excellent ore guides. The conclusion that the source of uranium is the altered host sandstone is supported by relative lack of uranium in altered ground opposed to relative abundance in fresh. Extensive low grade reserves in the northern Black Hills contain about 250,000 lb of U_3O_8 per mile of roll front. Roll fronts extend around the Black Hills and will ultimately be the main source of uranium in this area. — *from* Author's abstract

Reynolds, Merrill J. *See* Dott, Robert H., Sr. 06170

Rhodehamel, Edward C. *See* Minard, James P. 06112

06013 **Richter, Michael.** The design of a resources survey system, *in* Internat. Geosci. Electronics Symposium, 1st Ann. (Selected papers): IEEE Trans. Geosci. Electronics, v. GE-7, no. 4, p. 200-205, illus., 1969.

Orbital survey offers great promise for location and evaluation of resources. To exploit that potential, a system must be designed from the ground phenomena through the spacecraft and data handling to satisfaction of user requirements. The first step planned by NASA is the Earth resources technology satellite (ERTS). An alternative concept developed here is the Resources survey system (RSS), which produces optical-spectrum imagery with both photometric and photogrammetric fidelity. Data volume is determined and ground processing requirements developed into a conceptual system fully loading a second-generation computer. RSS is a prototype in that its limited performance can evolve without basic redesign into any foreseeable system, and operational in that its output is immediately and routinely usable. — *from* Author's abstract

06184 **Riecker, Robert E.; Rooney, Thomas P.** Water-induced weakening of hornblende and amphibolite: Nature, v. 224, no. 5226, p. 1299, illus., 1969.

To investigate the disparity between the great laboratory strength of silicates and the apparent weakness in nature (suggested by the stress drop associated with earthquakes), the possibility that water weakening might be induced in amphiboles at elevated pressure and temperature was investigated experimentally. Tests were run in a modified Griggs type solid pressure medium apparatus, at a constant strain rate of 10^{-5} sec^{-1}, at pressures from 5 to 20 kb and temperatures to 1,200°C. High temperature weakening at 800°C (independent of confining pressure) occurred in all experiments; a second strength anomaly appeared at high pressure and low temperatures. The cause of the anomalies is not entirely clear, but it is concluded that water weakening may lead to mechanical instability in the crust and oceanic upper mantle. — DBV

06327 **Rieder, R.; Wänke, H.** Study of trace element abundance in meteorites by neutron activation, Paper 8 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Sci. Libr., V. 12), p. 75-86, tables; discussion, p. 146-147, 1969.

About 20 elements with highly varying chemical and physical properties have been selected for study in meteorites by thermal neutron activation as a tool in investigation of physico-chemical conditions in the early planetary system and during formation of meteorite parent bodies. Data in general are in good agreement with previous determinations available in the literature. However, values for Na and K are about 10 percent lower; no explanation could be found for the discrepancy. Values of the uranium content range from 9-16 ppb for normal chondrites and between 80 and 185 ppb for achondrites. Indium shows a decrease in abundance with petrologic group number, and bronzite chondrites with light-dark structure show a striking excess of indium in dark, gas-rich portions. Chemical data tabulated include analyses of such meteorites as Fayetteville, Sioux County, Forest City, Richardton, and others. — VSN

Rieder, R. *See* Begemann, F. 06330

Riley, R. A. *See* Thurston, P. C. 06021

06024 **Riley, R. A.** Mulcahy Township, District of Kenora (Patricia Portion): Ontario Dept. Mines Prelim. Geol. Map P. 567, scale 1 in. to 88 feet, text, 1969.

Precambrian metavolcanics and metasediments underlie the northeast corner of Mulcahy Township; south and west the sequence can be traced by bodies of predominantly mafic metavolcanics within a complex of dioritic and granitic rocks. Faults are abundant with predominant direction east-west. Six major sulfide-rock type associations are present. — MCM

06103 **Rinehart, J. S.** Old Faithful geyser performance 1870 through 1966: Bull. Volcanol., v. 33, no. 1, p. 153-163, illus., 1969.

The performance of Old Faithful has been remarkably stable for the past 100 years. Rainfall and earthquakes have had little influence on its eruption cycle, although the Hebgen Lake earthquake of 1959 caused a sudden lengthening of the long interval

between eruptions. The principal change has been the gradual development of a bimodal character to the frequency distribution curve for the intervals between eruptions. — Author's summary

Rinehart, W. A. *See* Algermissen, S. T. 06268

06267 **Rinehart, Wilbur A.** A digital computer program for the location of local earthquakes, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 71-77, illus., 1969.

This paper discusses a digital computer program used to calculate hypocenters of earthquakes within range of a local network of seismic stations. This network was established in Alaska after the Prince William Sound Earthquake. A trial epicenter was determined by a graphical solution of time-difference hyperbolas prepared and plotted by the computer. The hypocenters were determined by a least-squares iterative method. — Author's abstract

Ringwood, A. E. *See* Ahrens, Thomas J. 06352

Ritchie, J. C. *See* Asmussen, Loris E. 06039

Ritzma, H. R. *See* Keller, E. R. 06225

06239 **Ritzma, Howard R.** Tectonic resumé, Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 57-63, illus., 1969.

The structural grain of the site of the present Uinta Mountains at the end of Cretaceous time was north-south. Intensely thrusted uplands existed to the west with broad foreland folds rippling away to the east. The Uinta anticline "popped up" at right angles to this older grain in latest Paleocene through middle Eocene time. The Paleocene and Eocene cover 30 million years, more than 40 percent of all Tertiary time. Uinta folding and faulting may have continued through 5 or 10 million years, certainly an adequate span of time when placed beside the time scale of orogenic events in California and elsewhere in the world. — Author's chronology

06073 **Roberts, Brian.** Paul Allman Siple [1908-1968]: Polar Rec., v. 14, no. 93, p. 851-859, portrait, 1969.

06018 **Robertson, J. A.** Township 157, District of Algoma: Ontario Dept. Mines Prelim. Geol. Map P. 561, scale 1 in. to 1/4 mi., text, 1969.

Rocks of Township 157 fall into four classes: Archean basement, Huronian sedimentary and volcanic rocks, post-Huronian mafic intrusives, and Pleistocene and Holocene unconsolidated sediments. Sulfides are characteristic of the area, and radioactivity is associated with the Mississagi Formation and member 3 of the Lorrain Formation. — MCM

Robertson, R. *See* Fritze, K. 05902

05680 **Robinson, J. E.; Charlesworth, H. A. K.; Ellis, M. J.** Structural analysis using spatial filtering in Interior Plains of south-central Alberta: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2341-2367, illus., 1969.

Structure contour maps illustrate two-dimensional wave forms with undulations at different widths or scales; spatially filtered (subsidiary) maps show only those undulations that fall within a certain scale-range. Data for 7,500 wells, covering 100,00 sq mi of the Interior Plains and 5,000-15,000 feet of Cambrian to Tertiary sedimentary rocks, were used to prepare structure contour maps of the top of the Devonian, the sub-Cretaceous unconformity, the base of the (Cretaceous) Fish Scales Sandstone, and the top of the (Cretaceous) First White Speckled Shale. On spatially filtered

maps of each surface, undulations in the 20-40 mile width-range show dominant (NE-SW and NW-SE) trends parallel to those in the Precambrian basement and suggestive of tabular structures bounded by steep-dipping faults; some undulations coincide with known petroleum occurrences. — BHK

06317 **Robinson, John Charles.** HRVA — A velocity analysis technique for seismic data [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1766B, 1969.

Robinson, W. E. *See* Anderson, P. C. 06176

05793 **Robison, Richard A.** Annelids from the Middle Cambrian Spence Shale of Utah: Jour. Paleontology, v. 43, no. 5, p. 1169-1173, illus., tables, 1969.

Two kinds of annelids, each represented by a single carbonized specimen, are described from the Spence Shale in northern Utah. *Canadia* sp. represents a genus previously reported only from the Middle Cambrian Burgess Shale in British Columbia, and *Palaeoscolex ratcliffei*, n.sp., represents a genus previously reported only from two shales of Tremadocian age in England. One common type of associated burrow questionably is assigned to *P. ratcliffei*, and two less common types of annelid-like burrows are described but not named. This is the second reported occurrence of annelid body fossils from Cambrian rocks of North America. Elsewhere, only two other occurrences of annelid body fossils have been reported in rocks of possible Cambrian age. — *from* Author's abstract

06183 **Robison, Richard A.** Fossil find furnishes link: Utah Geol. and Mineralog. Survey Quart. Rev., v. 3, no. 4, p. 1-2, illus., 1969.

Biologists have speculated that the phyla Echinodermata and Chordata probably had a common ancestor. It has been suggested that the ancestral echinoderm might look like the youngest embryological stage of certain living echinoderms. It is significant, therefore, that abundant dipleurula-like echinoderms were discovered in the Middle Cambrian Spence Shale in northern Utah. Several hundred specimens have been collected in the Wasatch Mts. They have a flattened, ovoid, flexible skeleton with double-layered marginal frame, near-bilateral symmetry, peculiar ctenoid feeding apparatus, and mouth and anus at opposite body poles. This would be the oldest known homalozoan. — ESL

06009 **Rodgers, P. W.** A note on the response of the pendulum seismometer to plane wave rotation [Addendum to 1968 paper]: Seismol. Soc. America Bull., v. 59, no. 5, p. 2101-2102, 1969.

This is an addendum to an earlier paper (ibid., v. 58, no. 5, p. 1385-1406, 1968; Abstracts of North American Geology, April 1969). It is shown that the rotational response of the pendulum seismograph is very much smaller than its acceleration response to a plane wave. The result holds for all horizontal pendulum seismometers or seismographs regardless of the particular instrumental parameters. The same type of formulation may be applied to the rotational response of a vertical pendulum seismometer excited by an incident Rayleigh wave. — DBV

05994 **Roed, Murray A.** An occurrence of chalcopyrite, Liard River, N.W.T.: Bull. Canadian Petroleum Geology, v. 17, no. 3, p. 347-353, illus., table, 1969.

Chalcopyrite, pyrite and quartz mineralization carrying minor amounts of chromium, nickel, and silver has been discovered in a fracture zone located 20 mi east of the Mackenzie Mountains along the Liard River in Northwest Territories. The fracture zone is in miogeosynclinal shale and siltstone of the Simpson Formation of Upper Devonian age. A number of dikes, possibly igneous in origin, are associated with the fracture zone at the locality. The occurrence of chalcopyrite in this particular geologic setting is new for western Canada. Also, the discovery has served to focus attention on the possibility of economic accumulations of base metals in this part of the western Canadian Sedimentary Basin. — Author's abstract

05816 **Roedder, Edwin.** Varvelike banding of possible annual origin in celestite crystals from Clay Center, Ohio, and in other minerals: Am. Mineralogist, v. 54, nos. 5-6, p. 796-810, illus., 1969.

Some celestite shows a rhythmic, paired banding that may be of annual origin, visible as straight, parallel, alternately dark and light bands, mainly parallel [210]. Thickness of individual bands and band pairs varies widely within a given crystal, but thicknesses are very uniform for sequences of hundreds of pairs. Individual pairs may be traced laterally without thickness change for 0.5 cm; some continue over former crystal terminations. They are visible owing to minute differences in index of refraction arising from variable substitution of barium for strontium. It is concluded that the warm brine from which the celestite grew was diluted with surface water that varied in composition or amount over a yearly cycle, causing banding. If the band pairs are varves, they yield valuable rate data on diagenetic processes and the hydrologic regimen. — *from* author's abstract

05989 **Rogers, Thomas H.** An active fault in the City of Hollister: California Div. Mines and Geology Mineral Inf. Service, v. 22, no. 10, p. 159-164, illus., 1969.

Hollister is located about 100 mi southeast of San Francisco, near the junction of the San Andreas and Calaveras fault zones. To clarify the nature of earthquakes and faults, some questions most often asked by visitors are answered. Right lateral displacement along the Calaveras fault zone is described at 13 sites in the city; maximum offset is about 12 in. — ESL

05905 **Römkens, Mathias Joseph Marie.** Migration of mineral particles in ice with a temperature gradient [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1456B-1457B, 1969.

Rona, C. *See* Emiliani, C. 06082

06136 **Rondot, Jehan.** Geology of the Rivière Malbaie area [also French edition]: Quebec Dept. Nat. Resources Prelim. Rept. 576, 30 p., tables, geol. map, 1969.

The southern part of the map-area is a hummocky plain while the north is the edge of a plateau with deep gorges. Precambrian rocks outcrop in the southeast corner. Early Paleozoic rocks of the St. Lawrence Lowlands and Appalachian types are present also, and glacial deposits cover half the area. Evidence of marine encroachment is found in terraces and abandoned shorelines. Fracturing in the south-central part produced shatter cones as well as linear features and may indicate a meteoritic origin for the Eboulement Mtn. area. No important mineralization was found. Analyses of 628 samples of stream sediments showed a few high molybdenum values along faults; results of analyses are tabulated. — ESL

Rooney, Thomas P. *See* Riecker, Robert E. 06184

06086 **Ropes, L. H.** Ground-water resources of the St. James area, south-central Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-334, scale 1:62,500, text, 1969.

The St. James area is covered by a thick layer of glacial drift which is underlain by Cretaceous, Cambrian, and Precambrian rocks. Water is obtained from two aquifers: Cretaceous sandstone 160 feet below surface yields abundant water of poor quality and expensive to treat, and surficial sand and gravel less than 40 feet thick at the well field produces water of better quality but its extent and capacity are not known. Because of the complexity of outwash deposits, great variations in permeability emphasize difficulties encountered in predicting material size and distribution at a given position and depth in the sand and gravel aquifer; local test drilling and sampling are necessary to estimate water yields and determine best well design. — MCM

05959 **Ross, Howard P.; Adler, Joel E. M.; Hunt, Graham R.** A statistical analysis of the reflectance of igneous rocks from 0.2 to 2.65 microns: Icarus, v. 11, no. 1, p. 46-54, illus., 1969.

Reflectance spectra from 0.2 to 2.65 microns were obtained for several igneous rocks and minerals. The reflectance of all the rock samples, when crushed, increases with decreasing particle size. A statistical analysis established the correlation between reflectance and the wavelength of energy, the generalized composition, and the particle size of the rock samples. Most of the absorption bands present in the spectra correspond to some form of water in the sample, or are common to unrelated rocks and minerals and, therefore, are not diagnostic of composition. A correlation analysis between the generalized composition variable and the ratios of reflectance at two different wavelengths has indicated correlation coefficients as high as 0.88 and may prove useful in selecting the more characterizing regions of the spectrum for remote sensing experiments. — Authors' abstract

Rucklidge, John C. *See* Elders, Wilfred A. 05999

05729 **Russell, John A.** Review — Natures secrets, or, the admirable and wonderfull history of the generation of meteors, by Thos. Willsford, Gent., London, Nath. Brook, 1658 [abs.]: Meteoritics, v. 4, no. 3, p. 205, 1969.

05904 **Rutledge, Elliott Moye.** Loess in Ohio — Composition in relation to several local rivers [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1464B, 1969.

05901 **Rye, Robert O.; Haffty, Joseph.** Chemical composition of the hydrothermal fluids responsible for the lead-zinc deposits at Providencia, Zacatecas, Mexico: Econ. Geology, v. 64, no. 6, p. 629-643, illus., tables, 1969.

Primary fluid inclusions in 22 samples of quartz, calcite, and sphalerite were chemically analyzed. Most K/Na ratios lie between 0.18 and 0.43, and when plotted against filling temperature mostly lie at least 100°C below White's (1968) curve for fluids in equilibrium with granitic rocks. Ca/Na ratios in sphalerite inclusions range from 0.12 to 0.61. Mg/Ca ratios were generally less than 0.08. Zn and Cu concentrations were probably less than 50 ppm during deposition of calcite and close to 500 ppm for quartz. Chloride is the major anion, and sulfur is generally below the level of detection. — WSW

06306 **Sadow, Ronald D.** Deep-well disposal of wastes — Discussion [of paper 6171 by William R. Walker and Ronald C. Stewart, 1968]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Sanitary Eng. Div., no. SA5, p. 966-967, 1969.

Compatibility of waste material (ibid., v. 94, no. SA5, p. 945-968, 1968) with the acceptance formation's resident material is desirable, but may not be as critical. A well in Alvin, Tex., has for five years accepted over 1 billion gal of concentrated mixed nitriles, organic complexes and dissolved sulfates in water, with no workover steps required. The receiving connate water is high in calcium and magnesium salts, but there have been no bore area blockages due to formation of insoluble calcium sulfates. An initial flush of pure water forms a buffer zone, obviating reactivity in the immediate bore area. A smaller well nearby, despite tested compatibility, required acidations and reperforation for acceptance of phenolic and hydrocarbon based waste. Even waste activated or biological sludges at around three percent solids can be successfully well injected, more in fractured zones or vugular limestones than in dense, permeable sand lenses. — GDC

05693 **Sainsbury, C. L.** The A. J. Collier thrust belt of the Seward Peninsula, Alaska: Geol. Soc. America Bull., v. 80, no. 12, p. 2595-2596, 1969.

The writer calls attention to the fact that thrust faults involving rocks from Precambrian to Cretaceous in age have gone unrecognized on the Seward Peninsula; consequently, all structural and pre-Jurassic stratigraphic relations published before 1965 are in error. The rocks are believed to more closely resemble those of the Chukotsky Peninsula of Siberia than contiguous parts of Alaska.

06353 **Sales, John K.** Regional tectonic setting and mechanics of origin of the Uinta uplift, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn.

Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 65-78, illus., 1969.

A huge, distributive, west-northwest oriented left-lateral couple, the main cause of the abnormally wide Cordillera and broken up foreland crust in the United States, is subdued in the latitude of the Colorado Plateau block because that block has held together and been translated bodily eastward. The couple is accentuated in Wyoming by the eastward translation of the Colorado Plateau block relative to the Canadian foreland. Most of the uplifts of Wyoming are crust-thick drag folds, the crust acting as a rigid semielastic slab floating on the mantle; the configuration of the deformation is strongly controlled by isostasy. Model experiments suggest that Berg's fold-thrust hypothesis is correct, and that the Uinta uplift has strong similarities and dissimilarities with other foreland uplifts. — *from* Author's summary

06208 **Sampsel, William H.** The Bowes gas field, Blaine County, Montana, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 161-164, illus., 1969.

Gas in Bowes field occurs in sands of the Eagle Formation. The gas is trapped in structures related to normal faulting and grabens as a result of gravity sliding along beds of bentonite within and below the Eagle. The structures above the slip plain are vastly more complex than those below. Bowes field is in a graben which has resulted from the bowing up of the Eagle and the subsequent sliding away from the crest of the arch, dropping part of the material downward into a graben-like structure. The structures within the graben are very complex. Over 30 billion cubic feet of gas have been produced from Bowes since 1926. — HRC

05794 **Sandberg, Philip A.** Appendages and family placement of the ostracod genus *Pellucistoma*: Jour. Paleontology, v. 43, no. 5, p. 1174-1178, illus., 1969.

The appendage morphology of a modern female specimen of *Pellucistoma* sp. (Cytheracea, Ostracoda) [from Core Sound, off Cape Lookout, N.C.] indicates clearly that the genus belongs in the subfamily Cytheromatinae, rather than the Paradoxostomatinae, in which it was originally placed [by Coryell and Fields (1937) for *P. howei* from the Gatun Formation (Miocene) of Panama]. —Author's abstract

Sandrea, A. *See* Cayé, R. 05836

05824 **Sands, Donald E.** Introduction to crystallography: New York and Amsterdam, W. A. Benjamin, Inc., 165 p., illus., tables, 1969.

This book should enable the nonspecialist to read and comprehend crystallographic literature and may serve as a starting point for those who wish to pursue the subject further. The first four chapters (crystals and lattices, symmetry, crystal systems and geometry, and space groups and equivalent positions) supply vocabulary and descriptions of crystal structures; use of mathematics has been kept to a minimum. Chapters 5 and 6 (X-ray diffraction and determination of atomic positions) attempt to show where the results come from; mathematical background required is elementary calculus. The final chapter describes some simple structures; principles learned from familiarity with these can be extended to more complex cases. Exercises of varying degrees of difficulty are distributed throughout the book. — MCM

05984 **Sangrey, D. A.; Henkel, D. J.; Esrig, M. I.** The effective stress response of a saturated clay soil to repeated loading [with French abs.]: Canadian Geotech. Jour., v. 6, no. 3, p. 241-252, illus., 1969.

Triaxial tests, under conditions of axial symmetry, were used and the rates of deformation were chosen so as to permit the accurate measurement of pore water pressure at all stages of the tests. It was found that, for any particular consolidation history, a critical level of repeated stress existed. Below this critical level, a state of nonfailure equilibrium was reached in which the stress-strain curves followed closed hysteresis loops. Above the critical level of repeated stress, effective stress failure occurred; and each cycle of loading produced cumulative increases in deformation. An in-

teresting feature of the test results was that a linear relationship between the magnitude of the applied repeated stress and the increase in pore water pressure was found for stress levels below the critical value. — *from* Authors' abstract

Sanz, H. G. *See* Wasserburg, G. J. 05908

06093 **Sargent, K. A.; McKee, E. H.** The Bates Mountain Tuff in northern Nye County, Nevada: U.S. Geol. Survey Bull. 1294-E, p. E1-E12, illus., tables, 1969.

The Bates Mountain Tuff, a widespread Miocene (K-Ar age about 22-24 million years) formation in central Nevada, crops out across a region of more than 1,900 square miles in northern Nye County, Nev. In the northwestern part of this region the formation comprises five cooling units, but only the upper two units can be traced eastward into east-central Nye County and only the upper unit can be found to the south in north-central Nye County. — Authors' abstract

06058 **Sass, Eytan.** Microphotometric determination of preferred orientation in undeformed dolomites: Science, v. 165, no. 3895, p. 802-803, illus., 1969.

Preferred orientation was observed in certain undeformed dolomites with a microphotometric technique. The preferred direction of the c-axis was found to be perpendicular to the bedding planes. The degree of orientation is rather slight, but is considered significant due to the fact that thousands of crystals are included in each measurement. It is suggested that the preferred orientation was acquired during an early diagenetic stage of dolomitization, when the individual crystals could rotate and adjust their position so that their maximum cross section tended to lie horizontally. — Author's abstract

06012 **Savage, J. C.; Hastie, L. M.** A dislocation model for the Fairview Peak, Nevada, earthquake: Seismol. Soc. America Bull., v. 59, no. 5, p. 1937-1948, illus., tables, 1969.

Maruyama's (1964) equations have been used to calculate vertical and horizontal surface displacements for a Volterra dislocation in a uniform half space; shape of the dislocation surface is assumed to be a plane rectangle. A least-squares procedure has been used to determine the dislocation surface which best fits geodetic data for the Fairview Peak, Nevada, earthquake, December 16, 1954. The best model strikes N. 9° E., has a total length of 50 km, a width of 8 ± 2 km, a dip of $57° \pm 6°$, and a fault displacement of 233 ± 0.4 m normal dip slip and 2.9 ± 0.4 m dextral strike slip. The N. 9° E. strike of the model is more realistic than the N. 4° W. to N. 11° W. strikes from nodal-plane solutions. The Dixie Valley earthquake of December 16, 1954, was associated with normal slip on a fault plane parallel to, but offset from, the fault plane of the Fairview Peak earthquake. — *from* Authors' abstract

Savino, John. *See* Molnar, Peter. 06182

Sbar, Marc L. *See* Lammlein, David R. 05894

05923 **Schauble, Carl Eugene.** Factors influencing copper availability in selected North Carolina coastal plain soils [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1457B, 1969.

06261 **Scheidegger, Adrian E.; Potter, Paul Edwin.** Textural studies of grading — Volcanic ash falls: Sedimentology, v. 11, nos. 3-4, p. 163-170, illus., 1968 [1969].

A theory of the lateral decrease in grain size and bed thickness with increasing distance of downwind transport is developed for ash falls. The theory is based on: the sediment load density of a turbulent slug of fluid, a turbulent diffusivity coefficient, and the decay of turbulent velocity fluctuations. All three factors are founded on empirical observation and are generally accepted as having widespread applicability to turbulent sediment-fluid mixtures. The theory yields good qualitative agreement with observational data. — Authors' summary

06229 **Schell, Elmer M.** Summary of the geology of the Sheep Creek Canyon geological area and vicinity, Daggett County, Utah, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 143-152, illus., table, 1969.

In the Sheep Creek Canyon area, the oldest exposed rocks are the Precambrian Uinta Mountain Group which is overlain in turn by Mississippian rocks; the Pennsylvanian Round Valley, Morgan, and Weber Formations; the Permian Park City Formation and related strata; Triassic Dinwoody, Chinle and Moenkopi; and the Jurassic Glen Canyon Sandstone, the youngest rock described. The area lies athwart the Uinta Mountain fault on the north flank, and this fault is described in some detail. The mineral resources of the area are numerous; brief descriptions of the phosphate deposits in the Permian are given. — HRC

Scherer, Oscar J. *See* Blaser, Harold D. 06288

Schilling, Jean-Guy. *See* deBoer, Jelle. 06054

Schlee, John. *See* Pratt, Richard M. 05877

06329 **Schnetzler, Charles C.; Philpotts, John A.** Genesis of the calcium-rich achondrites in light of rare-earth and barium concentrations, Paper 19 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 206-216, illus., table, 1969.

Rare-earth and barium concentrations are reported for three normal brecciated eucrites, two howardites, a chondrite composite, and the achondrites Serra de Magé, Moore County, Shergotty, and Angra dos Reis (stone). The brecciated basaltic achondrites have higher absolute rare-earth and barium concentrations than those in the average chondrite, but similar relative concentrations. Evidence suggests a hypabyssal or extrusive rather than plutonic crystallization. For the Sierra de Magé unbrecciated achondrite, however, compositions indicate a cumulate formed from a liquid of normal brecciated achondrite composition. Moore County is also a cumulate but with considerable post-accumulation closed-system competition indicated. Thus, since available data distinguish brecciated and unbrecciated achondrites as magma and cumulates respectively, different environments are suggested. — VSN

Schoellhamer, J. E. *See* Vedder, J. G. 06195

05672 **Scholtz, Judith Fessenden.** The Beaver Creek Volcanics — A new formation, Coconino-Yavapai Counties, Arizona: Geol. Soc. America Bull., v. 80, no. 12, p. 2637-2643, illus., table, 1969.

The Cenozoic volcanic rocks exposed in the West Beaver Creek Experimental Drainage basin are not part of the Hickey Formation as previously believed, but are volcanics that intertongue with and lie above beds of the Verde Formation, which was deposited on the eroded surface of the Hickey Formation.

06197 **Schoon, Robert A.** The Dakota Formation of South Dakota, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 203-211, illus., 1969.

Water analyses from the Dakota and subjacent formations are used to determine the source and nature of water recharge to the Dakota Sandstone. The interval between the Pennsylvanian Roundtop Shale and the base of the Cretaceous Skull Creek Shale yields a sodium sulfate water. The Inyan Kara sandstones in this interval are the main source of recharge to the Dakota. The Precambrian to Pennsylvanian interval yields calcium sulfate water in the southern half of the state. The Inyan Kara recharges the Dakota in the southeastern quarter. The change in the water characteristics of the Dakota, from connate sodium chloride to other types, occurs by physical changes and not ion exchange. Barriers to the migration of older formations waters to the Dakota appear to be the Pennsylvanian Roundtop Shale and the Cretaceous Skull

Creek Shale, and where absent, the Dakota can be recharged from subjacent units. — HRC

05695 **Schreiber, B. Charlotte.** New evidence concerning the age of the Hawaiian Ridge: Geol. Soc. America Bull., v. 80, no. 12, p. 2601-2604, illus., table, 1969.

Mixed terrigenous and pelagic sediment of Eocene age was recovered from the deep-sea floor 250 km east of Hawaii. These samples indicate Eocene terrigenous sedimentation from a well developed ridge source and imply a post-Eocene development of the Hawaiian Moat as a sediment trap. Another core that also contained Eocene sediment, mixed, however, with Oligocene and Miocene materials, was obtained from the flank of the Hawaiian Ridge, 100 km south of Kauai. — Author's abstract

Schultz, L. *See* Hintenberger, H. 05922

06339 **Schultz, L.; Huneke, J. C.; Nyquist, L. E.; Signer, P.** Spallogenic rare gases in taenite separated from iron meteorites, Paper 70 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 887-894, illus., tables; discussion, p. 934, 1969.

Isotopic composition and concentration of He, Ne, and Ar, produced by cosmic rays, were measured mass spectrometrically in total samples and taenite phases of iron meteorites to determine whether concentration of He-3 in taenite phase is higher than in kamacite, due to preferential diffusion of tritium in the latter. [Techniques of separation and calculation are described.] It was found that taenite has an unexpectedly high Ne concentration in comparison to that in the total sample, while Ar concentrations in taenite are comparable in 2 out of 3 cases with amounts in the total sample. He-3/He-4 ratios in taenite are less than in either kamacite or the total sample. Such Ne excess could indicate presence of target nuclei with mass numbers 20-40; such nuclei have not yet been detected with an electron microprobe in amounts to produce the excess Ne-21. — *from* Authors' abstract

Schumacher, Dietmar. *See* Freeman, Tom. 06321

06272 **Schwalb, Howard R.** Paleozoic geology of the Jackson Purchase region, Kentucky, with reference to petroleum possibilities: Kentucky Geol. Survey, ser. 10, Rept. Inv. 10, 40 p., illus., 1969.

Paleozoic rocks crop out along the eastern edge of the Jackson Purchase region but are buried to the west and southwest beneath unconsolidated Mesozoic and Cenozoic sediments with maximum thickness of 2,000 feet. A Cambro-Ordovician basin of sedimentation in western Tennessee is here named Reelfoot basin; the center of deposition moved northward into the Jackson Purchase in Late Ordovician time and a very thick section of sediments accumulated. This basin was later uplifted forming the Pascola arch, and erosion exposed Cambrian beds at the center. Later downwarping submerged the arch and allowed accumulation of Late Cretaceous and Cenozoic sediments in the present trough of the Mississippi embayment. The sequence of Cambro-Ordovician sediments in the Jackson Purchase is tilted to the north by the Pascola arch; potential structural, stratigraphic, and hydrodynamic traps should be present. — *from* Author's abstract

Sclater, J. G. *See* McKenzie, D. P. 06101

Scott, Nina H. *See* Cloud, William K. 06265

Seeber, Leonardo. *See* Auld, Bruce. 06033

Seilacher, Adolf. *See* Raup, David M. 06053

Senftle, F. E. *See* Thorpe, A. N. 06079

06098 **Sevon, W. D.** Sedimentology of some Mississippian and Pleistocene deposits of northeastern Pennsylvania, Field Trip 1-C *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., Atlantic City, 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 214-234, illus., 1969.

This report discusses the sedimentology of two unusual, temporally unrelated deposits in northeastern Pennsylvania. The first is the sequence from the Upper Devonian Catskill Formation into the Lower Mississippian Pocono Formation, with emphasis placed upon environmental interpretation of tilloid, pebbly mudstone and laminate lithologies. The second section treats the sedimentology of eleven Pleistocene boulder fields with emphasis on criteria of their formation — source rock, mechanism of boulder production, and mechanism of movement. Solifluction seems to be the most probable mechanism of origin for most boulder fields in Carbon County, especially of low gradient like Hickory Run field. Forrested boulder fields generally have no fine-grained matrix, but a 1-2-ft thick mat of humic debris, in places actively encroaching onto barren boulder field areas. — GDC

05787 **Shaw, Alan B.** Adam and Eve, paleontology, and the non-objective arts: Jour. Paleontology, v. 43, no. 5, p. 1085-1098, illus., 1969.

The concept of species is entirely subjective and it cannot serve to communicate the objective attributes of the original organism. The existing species concept implies a monotypic origin and does not permit expression of the more likely process of collateral evolution in widespread species. It is recommended that the species concept be replaced by a "language" that expresses the morphologic character as an individual entity throughout its stratigraphic range. A species complex of a platform conodont genus is used to illustrate the concept and the "language". — JWH

Shedlovsky, J. P. *See* Marti, K. 05864

05771 **Shelley, David.** The proportionality of quartz in myrmekite — A discussion [of paper by E. R. Phillips and D. M. Ransom, 1968]: Am. Mineralogist, v. 54, nos. 5-6, p. 982-984, illus., 1969.

The absence of quantitative data on quartz proportionality in myrmekite is due in part to difficulties in measuring the volme of vermicular bodies of quartz, and to the lack of consistent proportionality. Lack of proportionality of quartz to plagioclase seriously weakens Schwantke's exsolution hypothesis. It is suggested that the amount of quartz in myrmekite is more truly related to speed of growth of the plagioclase, the amount of quartz available at the growth site, and its state of readiness to recrystallize. For original paper see ibid., v. 53, p. 1411-1413, 1968. — ESL

05812 **Sheppard, Richard A.; Gude, Arthur J., 3d.** Chemical composition and physical properties of the related zeolites offretite and erionite: Am. Mineralogist, v. 54, nos. 5-6, p. 875-886, illus., tables, 1969.

New chemical analyses as well as optical and X-ray data show that offretite and erionite are closely related hexagonal zeolites. Offretite is alkaline earth rich and has a $Si/(Al+Fe^{3+})$ ratio of 2.48, whereas erionite is generally alkali-rich and has a $Si/(Al+Fe^{3+})$ ratio of 2.92 to 3.74. Ferric iron may substitute for aluminum in erionites from sedimentary deposits. The optic sign is negative for offretite and positive for erionite. Offretite characteristically has indices of refraction that are higher than those for erionite. A decrease in the indices of refraction and the cell volume of erionite can be correlated with an increase in the $Si/(Al+Fe^{3+})$ ratio.—Authors' abstract

06266 **Sherburne, R. W.; Algermissen, S. T.; Harding, Samuel T.** The hypocenter, origin time, and magnitude of the Prince William Sound earthquake of March 28, 1964, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 49-69, illus., tables, 1969.

Ten separate epicenter computations were made using various data sets, computer programs, and traveltime curves. The preferred epicenter, using 46 stations paired in distance and azimuth, Jeffreys-Bullen [1958] traveltime curves, and the epicenter computer program of the Coast and Geodetic Survey has coordinates latitude 61.04 W., longitude 147.73 S., origin time 03:36:14.0. The focal depth was fixed at 33 km. Indications of possible surface faulting were found 38 km N. 31° E. of the instrumental epicenter. A study of P(O-C) time residuals at the College, Alaska, station shows a crustal thickening beneath the Chugach Mountains or possibly higher than normal mantle velocities beneath Prince William Sound. The mean value of M_s was $8.3 \pm .33$ magnitude units using 37 observations. — Authors' abstract

Sherburne, R. W. *See* Algermissen, S. T. 06268

06293 **Sherif, Mehmet A.; Burrous, Chester M.** Temperature effects on the unconfined shear strength of saturated, cohesive soil, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 267-272, illus., table, 1969.

The following conclusions can be made about C and C clay consolidated at 75°F and sheared at 75°, 100°, 125°, 150°F in unconfined and undrained compression: (1) An increase in temperature causes a decrease in compressive strength; moreover, an increase in temperature is analogous to an increase in moisture content. (2) A linear relationship exists between logarithm of compressive strength and moisture content of all test temperature levels; the failure lines at constant temperatures appear to be almost parallel to the consolidation curve. (3) Soil samples of lower moisture contents undergo greater absolute reduction in strength with rising temperatures than those of higher moisture content levels. — *from* Authors' conclusions

06110 **Shields, Ronald R.; Sopper, William E.** An application of surface geophysical techniques to the study of watershed hydrology: Water Resources Bull., v. 5, no. 3, p. 37-49, illus., tables, 1969.

The applicability of geophysical methods to experimental watershed research is demonstrated by a study of a 106-acre forested watershed in central Pennsylvania. Data from a shallow seismic refraction study and an electrical resistivity study of the watershed were used to determine the depth of soils, their volumes, depth to bedrock, configuration of the bedrock surface and delineation of the bedrock surface and delineation of the water table. With this information on the subsurface conditions, the hydrologic properties of the watershed were described in greater detail. This information will be of value in explaining the watershed's response to various watershed treatment practices that eventually will be used. — Authors' abstract

05862 **Shima, Masako; Imamura, Mineo; Matsuda, Hideki; Honda, Masatake.** Some stable and long-lived nuclides produced by spallation in meteoritic iron, Paper 28 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 335-347, illus., tables; discussion, p. 351, 1969.

Concentrations of cosmic-ray produced stable nuclides of Cr, V, Ti, and Ca, and long-lived radioactive nuclides K-40 and Mn-53 were measured in iron meteorites. In the Grant meteorite they were determined as a function of depth of the specimen. Enrichment of Ti-49 was observed most prominently in mass spectrum of Ti samples separated from the meteorites. Ti-47 and -46 were measurable with high reproducibility and Ti-50 was measurable. In Grant, the depth variation was effectively negligible with Ti-49 and its neighbors in contrast to other nuclides such as Ne and K-40. Variations of mass-yield relationship indicate the effect of shielding on spallation production during the exposure period. Distributions of Mn-53 are compared with Cr-53. — *from* Authors' abstract

05873 **Shirck, J.; Hoppe, M.; Maurette, M.; Walker, R.** Recent fossil track studies bearing on extinct Pu^{244} in meteorites, Paper 5 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 41-50, illus.; discussion, p. 62, 1969.

Certain meteorites contain stored fission track densities in excess of those attributed to spontaneous fission of uranium; previous work has shown that their most likely source is spontaneous fission of extinct Pu-244. New results are presented on two meteorites of particular interest. Preliminary measurements in Campo del Cielo (El Taco) and Kodaikanal have been interpreted previously as evidence for a relatively high Pu/U ratio at the end of nucleosynthesis; measurements reported here, using improved techniques, do not confirm this. The ratio of Pu to U fission tracks in Campo del Cielo, found to be 61 ± 14, is consistent with either a sudden synthesis model or a continuous galactic synthesis model of heavy element production. Stored tracks in Kodaikanal appear due to heavy cosmic rays and are irrelevant to the Pu problem. — *from* Authors' abstract

Signer, P. *See* Nyquist, L. E. 06338

Signer, P. *See* Schultz, L. 06339

05890 **Sikander, Abdul Hakim.** Joint patterns in lower Paleozoic rocks of western Gaspé, Quebec: Geol. Soc. America Bull., v. 80, no. 11, p. 2321-2325, illus., tables, 1969.

Joints were studied in open to tightly folded Paleozoic rocks of various lithologies. Dip, strike, and oblique joints are normal to bedding in competent, well-bedded sandstone, siltstone, and limestone. In calcareous slate, steep dip sets predominate, accompanied by oblique sets usually perpendicular to bedding; rare strike joints are normal to cleavage. In slate, the dip joints are the predominant set sometimes accompanied by a secondary strike set perpendicular to the cleavage. The dip joints in slates bear no consistent angular relationship to variably plunging meso-fold axes. Thus, it is suggested that the joints are independent of the geometry of local folds, are not due to extension along fold axes during the main phase of folding, but are later in origin. — Author's abstract

Sills, I. D. *See* Aylmore, L. A. G. 06295

05674 **Silver, Burr A.; Todd, Robert G.** Permian cyclic strata, northern Midland and Delaware basins, west Texas and southeastern New Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2223-2251, illus., table, 1969.

Five regionally extensive lithofacies comprise an unconformity-bounded sequence in Wolfcampian-Guadalupian rocks of the northern Permian basin. Shelf to basin correlations are based on tops of detrital units. The following model is suggested: During normal sea level, shelf-margin carbonate reefs and banks formed; broad backreef lagoons prevented terrigenous sand from reaching the basin, where pelagic mud and micrite accumulated. Relative lowering of sea level, possibly eustatic-epeirogenic initiated regression; sand and mud prograded across the lagoon; shelf detritus entered the basin through shelf-margin reentrants and submarine canyons. More regression exposed shelf clastic beds, providing an unconformity-delimited datum surface. Transgression reactivated normal carbonate deposition. — EGS

06071 **Silverman, Daniel.** Mapping the Earth with elastic wave holography, *in* Internat. Geosci. Electronics Symposium, 1st Ann. (Selected papers): IEEE Trans. Geosci. Electronics, v. GE-7, no. 4, p. 190-199, illus., 1969.

Remote sensing of the Earth has been carried on for years by use of transient elastic waves. With the advent of optical holography and development of high-power sonic sources and electromechanical vibrators, it is now possible to map subsurface structure of the Earth with steady-state coherent waves, earth holography, providing a three-dimensional view of the interior. Basic principles of wavefront reconstruction in optics are reviewed and their application to sonic and seismic wave holography discussed. It is shown that the sampling density required is within practical field limits for adequate resolution. Experiments were carried out using frequencies in the low MHz range and small metal objects. Resulting holograms and photographs of reconstructed images are shown. Possible extensions of this work to large-area, deep mapping of the oceans and the Earth are outlined. — *from* Author's abstract

Simonenko, A. N. *See* Levin, B. Ju. 05852

05913 **Sims, William Eldon.** Methods of magnetotelluric analysis [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1766B, 1969.

05840 **Singer, S. Fred.** Interplanetary dust, Paper 49 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 590-599, illus., tables; discussion, p. 627-629, 1969.

The existence of dust in the solar system can be inferred from astronomical observations of zodiacal light, impact penetrations on space vehicles, chemical and radiochemical analyses of deep sea sediments. An interpretation of these and other data has been made and used to derive physical properties of interplanetary dust particles: size, shape, density, composition, surface properties as well as orbital properties such as inclination to ecliptic and distribution in space. Since the dust cloud is subject to constant attrition by many processes, it is necessary to postulate a more or less continuous source of resupply. On the basis of theoretical analysis, it appears that neither the short- nor long-period comets can maintain interplanetary dust, so that it is most likely from asteroids and meteorites. — *from* Author's abstract

06113 **Singh, Krishan P.** Theoretical baseflow curves: Am. Soc. Civil Engineers Proc., v. 95, paper 6905, Jour. Hydraulics Div., no. HY6, p. 2029-2048, illus., tables, 1969.

Baseflow curves are obtained by solving a nonlinear partial differential equation of groundwater flow for different boundary conditions. A theoretical basis is provided for differentiating between these curves for shallow and deep aquifers. Various linearized solutions and their limitations and errors are elucidated. Mathematical expressions are derived for the effects of evapotranspiration and leakage loss in substantially reducing the baseflow and rendering the stream influent or dry. Upward leakage from an underlying artesian aquifer causes the baseflow to be more sustained and reduces its recession rate. Aquifer recharge of duration T, simulated by a sine function, leads to a baseflow hydrograph which peaks at 0.75 T and becomes parallel to the no-recharge curve after about 1.5 T. — ASCE abstract

05948 **Singler, Charles R.** Sedimentology of the White River Group (Oligocene) in northwestern Nebraska [abs.]: Dissert. Abs. Internat. Sec. B, Sci. and Eng., v. 30, no. 4, p. 1759B, 1969.

Skerra, B. *See* Herr, W. 05871

05897 **Slemmons, David B.** Surface faulting from the December 26, 1869 Olinghouse, Nevada earthquake [abs.]: Earthquake Notes, v. 40, no. 2, p. 23, 1969.

06348 **Smith, A. L.; Carmichael, I. S. E.** Quaternary trachybasalts from southeastern California: Am. Mineralogist, v. 54, nos. 5-6, p. 909-923, illus., tables, 1969.

Quaternary volcanism in southeastern California has produced scattered cinder cones and lavas of trachybasalt. Typically the lavas contain magnesian olivine and titanaugite which becomes progressively enriched in Ca, Al and Ti towards the crystal margins. Oscillatory and hourglass zoning with abrupt changes in Ti, Al and Si (inversely) have been observed in some titanaugites. Plagioclase may zone from labradorite to anorthoclase, and discrete sanidine is present in coarsest grained lavas; iron-rich residual glass is enriched in normative nepheline which is absent modally. Titanomagnetite (microphenocryst and groundmass phases) is notably rich in MgO and Al_2O_3 in contrast to equivalent tholeiitic assemblages. Analyses show that lavas are not simply related to one another by fractionation of phenocryst phases; the controlling factor remains obscure as typically the most silica-poor lavas are the most alkali rich. — Authors' abstract

06091 **Smith, Avery E.** Map showing bedrock topography and subcrop of selected beds beneath alluvial deposits of the Sutherland quadrangle, Daviess County, Kentucky: U.S. Geol. Survey Misc. Geol. Inv. Map I-596, scale 1:24,000, 1969.

06118 **Smith, Bennett L.** The Precambrian geology of the central and northeastern parts of the New Jersey Highlands, *in* Geology of selected areas in New Jersey and eastern

Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 35-47, illus., tables, 1969.

Re-examining Precambrian geology of the Highlands area as a whole, a simplified compilation of 22 7 1/2-min quadrangles tentatively reconciles map legends and petrologic data elaborated in Table 1. Rock types are described, with five tables of typical modal analyses. Gneisses are steeply folded and overturned to the northwest, pervasive mineral lineation tends to be concordant from one rock type to another, and they are cut by three sets of faults. Mesozoic trap dikes tend to concentrate near north-south striking faults. Drake and others (1967) have interpreted the Precambrian along the Delaware River as part of a large nappe resting on Paleozoic. Smith suggests that Precambrian rocks may be rooted in northeastern New Jersey, and allochthonous in the Pennsylvania part of the Reading Prong. Mineral assemblage in the hypersthene-quartz-andesine belt is characteristic of granulite metamorphic facies. — GDC

06374 **Smith, Bennett L.** Engineering geology of the Yards Creek hydro-electric pumped storage project, Field Trip 5 *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J. Rutgers Univ. Press, p. 348-353, illus., 1969.

The Yard Creek project has involved construction of two reservoirs five miles northeast of Delaware Water Gap, N.J., one on top of Kittatinny Mountain and a larger one 700 feet below that on the south side. The upper site, underlain by the Shawangunk Formation, is athwart the axis of a syncline plunging 10-12° southwesterly. The Martinsburg Formation (Ordovician) is bedrock in the lower site. Materials for earth dams and other structures and sand and gravel for filtering were available locally. Overburden, 50 feet thick in the channel at the lower dam, consisting of shallow organic silt underlain by varved silts and sand, gravel and boulders and till, required a slurry trench to an impervious formation. Water from the Delaware River could be pumped up from Tocks Island. — GDC

Smith, Guy D. *See* Flach, Klaus W. 06142

06180 **Smith, Robert B.** Seismic survey scientists explore lake: Utah Geol. and Mineralog. Survey Quart. Rev., v. 3, no. 4, p. 6-7, illus., 1969.

Little is known about the subsurface geology of Great Salt Lake and its unique association with Basin and Range structures. After a trial sparker profile from Promontory Point to Lakeside showed the bottom and subbottom sediments dipping east and ending in a Glauber's salt basin at a normal fault, a complete seismic survey was run. The shallow depths and areas of high velocity salt beds and algal reefs caused problems. Preliminary interpretations indicate deeper basin development at the south end. A total field magnetometer survey of the lake is planned this year. — ESL

06006 **Smithson, Scott B.; Hodge, Dennis S.** Petrology and geochemistry of the Laramie batholith and related metamorphic rocks of Precambrian age, eastern Wyoming — Discussion [of paper by K. C. Condie, 1969]: Geol. Soc. America Bull., v. 80, no. 11, p. 2383-2384, 1969.

Various points are cited to show that neither Condie's [ibid., v. 80, no. 1, p. 57-82, 1969] field observations nor his petrochemical data support the conclusions that there is a Laramie "batholith". Detailed field studies in the southern part of Condie's area are cited to show that the thick sequences of granitic gneisses could be metamorphosed felsic volcanic flows, tuffs, or even sedimentary rocks that extend northward to Condie's "batholith". Much more detailed field work, careful sampling, and accuracy and precision of chemical analyses are needed for Condie's data to be useful. — VSN

05775 **Society of Economic Geologists; Parker, Ronald B.; Harshman, E. N.** (editors). Wyoming uranium issue [Field conference on uranium deposits in Wyoming, 1969]: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, 149 p., illus., tables, 1969.

This is one of a series of commodity-oriented field conferences sponsored by the Society of Economic Geologists. The principal uranium mining areas of Wyoming are described; opinions on the genesis of the deposits are presented in the eight papers cited separately. — ESL

06226 **Sohn, I. G.** *Pseudoleperditia* Schneider, 1956 (Ostracoda, Crustacea), an Early Mississippian genus from southwestern Nevada: U.S. Geol. Survey Prof. Paper 643-C, p. C1-C6, illus., 1969.

Pseudoleperditia Schneider, 1956, described from the Tournaisian of Russia, is redefined. Silicified specimens from the Narrow Canyon and lower Mercury Limestones in southwestern Nevada, representing growth stages and adults of *P. poolei* n.sp., demonstrate that the genus is dimorphic and asymmetrical with regard to the anterior spines. This genus is the first known Early Mississippian representative of the Beyrichicopina, which formerly was restricted to rocks of early Paleozoic age. — Author's abstract

Sopper, William E. *See* Shields, Ronald R. 06110

06360 **Souther, J. G.; Halstead, E. C.** Mineral and thermal waters of Canada, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc. Symposium 2, Mineral and thermal waters of the world — [Pt.] B, Oversea countries (Rept., V. 19): Prague, Academia, p. 225-256, illus., tables, 1969.

In Canada, thermal springs are those whose temperatures are more than 5°C (or 10°F) above the mean annual air temperature of the region; of these, those with temperatures >90°F are called hot springs and those with temperatures <90°F warm. They are confined to the Cordilleran region; 58 are at or near valley bottoms (47 along major faults) and 32 occur in or near Tertiary plutons. Surprisingly, there is little correlation with areas of recent volcanism. The great majority of mineral and thermal springs are believed to be meteoric waters that have circulated deeply. — DBV

05673 **Southwick, David L.** A note on the occurrence of kyanite and chloritoid in some metaconglomerates in Maryland: Geol. Soc. America Bull., v. 80, no. 12, p. 2645-2651, illus., table, 1969.

Kyanite and chloritoid occur together in two units of metaconglomerate in the Appalachian Piedmont of Maryland. Surrounding pelitic schists consist chiefly of chlorite, albite, epidote, muscovite, and quartz with chloritoid and garnet present locally; kyanite is lacking. Black graphitic slate closely associated with kyanite; and chloritoid-bearing metaconglomerate contains abundant chloritoid but no kyanite, even though it is an Al-rich rock. Differences in MgO and alkali content are sufficient to explain the presence of kyanite in the metaconglomerates and its absence from associated pelitic schists. The reducing environment in the graphitic slates may explain why kyanite is not found there but forms in the more oxidized metaconglomerates. — *from* Author's abstract

06242 **Spaeth, Mark G.; Berkman, Saul C.** The tsunami of March 28, 1964, as recorded at tide stations, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 223-307, illus., tables, 1969.

The tsunami generated by the Prince William Sound Earthquake of March 28, 1964, was the largest since the 1960 Chilean tsunami. Seiche action was damaging as far away as the Gulf of Mexico. This report contains 107 reproductions of tide curves showing the tsunami and 12 curves showing oscillations induced by the long-period seismic waves, 10 in the Gulf of Mexico and the Caribbean Sea, and 2 at Arkansas damsites. A brief history of the Seismic Sea Wave Warning System (Tsunami Warning System since March 15, 1967) and a report of its operation during the tsunami warning action are included. One hundred and twenty-two fatalities and over 104 million dollars in damage resulted, and these are tabulated together with detailed data on wave heights and arrival times at various stations throughout the Pacific. — Authors' abstract

05845 **Spannagel, G.; Heusser, G.** Radiation ages of chondrites, Paper 31 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 372-386, illus., tables; discussion, p. 458-459, 1969.

Cosmic-ray produced activities have been studied in 5 amphoterite-, 7 hypersthene-, and 2 bronzite-chondrites. Exposure ages were derived from the Al-26 activity, the Ar-39 activity, and the rare-gas content. The age distribution shows peaks for the bronzite chondrites and the amphoterites at 5×10^6 yr and 12×10^6 yr, respectively; age of hypersthenes scatter between 1 and 40×10^6 yr. The Al-26/Ne-21 exposure ages are compared with the Ar-39/Ar-38 exposure ages and deviations of ± 20 percent are found. — *from* Authors' abstract

05691 **Speed, Robert C.; Jones, Thomas A.** Synorogenic quartz sandstone in the Jurassic mobile belt of western Nevada—Boyer Ranch Formation: Geol. Soc. America Bull., v. 80, no. 12, p. 2551-2584, illus., tables, geol. map, 1969.

The name Boyer Ranch Formation is proposed for a lithosome of homogeneous Jurassic quartz sandstone and basal conglomerate and limestone up to 500 feet thick in the Dixie Valley region in western Nevada. The sandstone is anomalously mature compared to subjacent and coeval clastic rocks. Prior to the onset of orogeny in late Early or Middle Jurassic time the sand was probably undergoing eolian saltation. Subsequently the sand was deposited in the low-energy shoreline environment of local troughs created by orogeny. The rocks of this formation are the youngest terrigenous rocks of Mesozoic age in the region. — WHN

Spiess, Fred N. *See* Larson, Roger L. 06066

05870 **Sprenkel-Segel, E. L.** Mössbauer investigation of the unequilibrated ordinary chondrites, Paper 10 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 93-105, illus., tables; discussion, p. 149-150, 1969.

A search for sources of iron was made in the Mössbauer absorption spectra of the unequilibrated ordinary chondrites. Spectra show that the FeO contents reported in chemical analyses occur almost entirely in form of ferrous minerals with absorption patterns corresponding to olivine and pyroxene. Virtually no magnetite was found and the required amounts of iron are not present. Large amounts of FeO reported in chemical analyses are not accounted for in the olivine-pyroxene systems described by the electron-microprobe work on the most unequilibrated ordinary chondrites. The Mössbauer spectra require that this FeO be present as high-iron olivine and/or pyroxene (presumably in a microcrystalline phase) or another ferrous mineral whose absorption pattern overlaps the olivine-pyroxene absorption. — *from* Author's abstract

06004 **Stanley, Daniel J.** Armored mud balls in an intertidal environment, Minas Basin, southeast Canada: Jour. Geology, v. 77, no. 6, p. 683-693, illus., tables, 1969.

On the inclined gravel-covered platform of the upper tidal zone in this eastern arm of the Bay of Fundy, water action rapidly shapes angular blocks of eroding Pleistocene plastic mud into sand- and pebble-coated triaxial ellipsoids. The most common length of the longest axis is about 3 inches. Parallelism of this axis to the shoreline and roundness of the balls increase from the upper to the lower part of this tidal zone. Some of the balls are partly buried. If preserved in ancient deposits, similar balls can be paleogeographically contrasted to the unarmored more spherical mud balls formed in alluvial flood-plain and deep marine environments. — VES

Starkweather, Jack. *See* Poole, Lafayette E. 06206

Starkweather, Jack. *See* McDade, L. B. 06207

06240 **Steenland, Nelson C.** An aeromagnetic survey of the Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 47-51, illus., 1969.

An aeromagnetic survey of the Uinta Mountains and the adjacent basins shows a minimal anomaly over the mountains very similar to the results of a ground study by Behrendt and Thiel published in 1963. However, the interpretation of the airborne data shows that the minimum is actually not negative but simply a nonanomalous area between two intrabasement anomalies caused by changes in magnetization within the magnetic basement or within the Lower Precambrian beneath the metasedimentary series of the Middle and Upper Precambrian. Consequently, the mountain mass is considered to be a nonmagnetic suite of metasediments in the form of a wedge of material more than 35,000 feet thick and about 110,000 feet wide on outcrop within the surveyed area. — Author's abstract

Stefansson, Unnsteinn. *See* Atkinson, Larry P. 06016

06173 **Steiger, R. H.; Wasserburg, G. J.** Comparative U-Th-Pb systematics in 2.7×10^9 yr plutons of different geologic histories: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1213-1232, illus., tables, 1969.

A comparative study was made of the Pb-U-Th systematics on cogenetic zircons from the plutons in the Superior Province (Canada), the Grenville front, and the Wind River Mountains (Wyoming). It is concluded that unless independently documented, the secondary ages inferred by the episodic model are in general invalid. The zircon systematics appear to be dominated by the occurrence of highly discordant and almost concordant phases. The discordant phase responding to diffusion loss may be in the nonlinear region. — GV

06037 **Stephenson, G. R.; England, C. B.** Digitized physical data of a rangeland watershed: Jour. Hydrology, v. 8, no. 4, p. 442-450, illus., 1969.

Data related to physical land features [of Idaho] were extracted from a series of survey maps by plotting, and transferred to punch cards in digitized form. Terrain profiles developed from the data were examined to determine relationships between soil occurrence, slope, aspect, and geologic parent material. As a result of the consistency of these relationships, a variable designated as an index of total profile porosity was computed for 2565 sampling points on the 90-sq-mi Reynolds Creek experimental watershed. This index value, ranging from 0.5 to 18 inches potential soil-water storage capacity, varies with slope, aspect, and geologic parent material. Each soil mapping unit, by nature of its depth, texture and percent rockiness, has a particular index value. By grouping the soils by index values, a realistic hydrologic grouping was established for the watershed. — *from* Authors' conclusions

Stern, T. W. *See* Rankin, D. W. 06064

06246 **Steven, Thomas A.** Possible relation of mineralization to thermal springs in the Creede district, San Juan Mountains, Colorado — A discussion [of paper by D. E. White]: Econ. Geology, v. 64, no. 6, p. 696-698, 1969.

A variety of evidence suggests that the connection between epithermal base-metal deposits and thermal springs noted by White [*in* Geochemistry of hydrothermal ore deposits, H. L. Barnes (editor)], is based on faulty evidence, and may or may not exist. — WSW

06087 **Stokes, William Lee.** Scenes of the plateau lands and how they came to be: Salt Lake City, Utah, privately printed, 66 p., illus., 1969.

The area covered in this semipopular account is the Four Corners region where Utah, Colorado, Arizona, and New Mexico meet. The chief tool that has created the scenery has been running water; the chief technique, erosion; and chief material, beds of bare sandy rock. Sections of the book are: rocks make the scene; rocks hard and soft, large and small; fractured rocks; colors of rocks; cliffs; mesas and buttes; canyons; badlands; arroyos, washes and gullies; monuments; some canyons in particular; natural bridges, arches and windows; sand dunes; volcanoes; petrified forests and dinosaur graveyards; Meteor Crater; and rocks for man. — MCM

06255 **Stokes, William Lee.** History of geological exploration of the Uinta Mountains, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 17-21, illus., 1969.

The first persons to use the range were fur trappers, and not until the Powell survey of 1868 was the range investigated by scientists. Powell was followed shortly by King in 1869, and Hayden made a short examination in 1870. Powell's work was in connection with his investigation of the Colorado River. He was chiefly a stratigrapher and noted the great sequence of Mesozoic and Cenozoic strata on the flanks. King noted the effects of glaciation, whereas Hayden called attention to the quartzite core of the range which he and King considered to be Carboniferous. Later, other important geologists visited the region, and slowly the true geologic picture of the range emerged. Atwood's work on the glaciation is considered a classic. — HRC

Stone, Donald B. *See* Namowitz, Samuel N. 05979

06314 **Stringfield, V. T.; LeGrand, H. E.** Hydrology of carbonate rock terranes — A review, with special reference to the United States [Pt. 2]: Jour. Hydrology, v. 8, no. 4, p. 377-417, illus., 1969.

This section of the paper (Pt. 1, ibid., no. 3, p. 349-376, 1969) deals with: (1) carbonate aquifers — their water-bearing properties, occurrence and movement of water, rate of movement, relation of movement to geologic structure, relation of surface-water hydrology to subsurface features, quality of water, contamination of water, and relation of salt water to fresh ground water; (2) springs; (3) wells; (4) practical problems; (5) methods of investigation; and (6) present status of knowledge and need for future research. The bibliography of 167 references consists mainly of reports on the United States. — GDC

Subitzky, Seymour. *See* Geological Society of America. 06114

06326 **Suess, Hans E.** Nuclear abundance rules and the composition of meteorites, Paper I *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 3-6, illus.; discussion, p. 60, 1969.

Abundances of nuclear species, estimated from chemical composition of meteorites, follow certain regularities which indicate that chemical fractionation processes have not completely obscured primeval abundance ratios of elements. Regularities can be expressed as rules, which are manifested to a different degree in different types of meteorites and give indication of most primeval type of material. Composition of Type I carbonaceous chondrites shows less fractionation than any other type; differences in volatility were probably the cause of fractionation. Should observations continue to indicate iron enrichment in all types of stony meteorites, then differences in volatility could also be considered the main cause of fractionation. Enrichment of Fe, would have to have occurred at a much earlier stage than the fractionation indicated by composition of ordinary chondrites as compared to Type I carbonaceous chondrites. — *from* Author's abstract

Summers, A. L. *See* Fricker, P. E. 05753

05906 **Suryanarayana, Bhamidipaty.** Mechanics of degradation and aggradation in a laboratory flume [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1698B, 1969.

05801 **Swartz, Frank M.** Ordovician ostracode *Aparchites whiteavesi* Jones (1889), and problems of relationships: Jour. Paleontology, v. 43, no. 5, p. 1237-1244, illus., 1969.

The holotype and only known specimen of *Aparchites whiteavesi*, genotype of *Aparchites*, collected from Middle Ordovician beds in Manitoba, is reillustrated and described. The specimen is poorly preserved, and both the genus and the family Aparchitidae are questionable in scope and relationships. — JWH

Sykes, Lynn R. *See* Molnar, Peter. 06182

06108 **Sylvester, Rita D.** (compiler). List of Bureau of Mines publications and articles, January 1 to December 31, 1968, with subject and author index: U.S. Bur. Mines Spec. Pub., 119 p., 1969.

06245 **Szabo, Barney J.; Malde, Harold E.; Irwin-Williams, Cynthia.** Dilemma posed by uranium-series dates on archaeologically significant bones from Valsequillo, Puebla, Mexico: Earth and Planetary Sci. Letters, v. 6, no. 4, p. 237-244, illus., tables, 1969.

A uranium-series date determined for bone associated with an artifact agrees with a radiocarbon date for fossil mollusks in the same bed and indicates Man's presence more than 20,000 years ago. However, some of these bone dates exceed 200,000 years. Because such dates for Man in North America conflict with all prior archaeological evidence here and abroad, we are confronted by a dilemna — either to defend the dates against an onslaught of archeological thought, or to abandon the uranium method in this application. A sample from the Lindenmeier site north of Fort Collins, Colorado and another from Pleistocene terrace along the Arkansas River were also dated. — *from* Authors' abstract

Takahashi, Taro. *See* Li, Yuan-Hui. 05910

05995 **Talbot, Christopher J.** Petrology and structure of the El Pinal tonalite, Baja California, Mexico — Discussion [of paper by W. A. Duffield, 1968]: Geol. Soc. America Bull., v. 80, no. 11, p. 2387-2389, illus., 1969.

Talbot suggests another explanation for the structural pattern in the El Pinal Tonalite which was explained by Duffield (ibid., v. 79, p. 1351-1374, 1968) on the basis of an "overlying ring fracture" model. He suggests that the structure is a section through a former magma chamber that underwent thermal convection for part of its cooling history — that is, it is a primary flow phenomena. The "thermal convection" model implies that the El Pinal Tonalite is more deeply eroded than the "overlying ring fracture" model. — VSN

Tamhane, A. S. *See* Lal, D. 05860

06285 **Tasch, Paul; Kidson, Evan.** Lower Permian algal stromatolites from Kansas and Oklahoma — Pt. 1, Paleoecological observations on Wellington algal stromatolites from Kansas and Oklahoma: Kansas Univ. Paleont. Contr.-Paper 43, p. 1-9, illus., 1969.

Paleoecological data are reported for brackish-water(?) calcareous algae of the Wellington Formation. Algal facies recur vertically at several localities. Pellet-ostracode bands were found in numerous digitate algal masses. Mini-erosive events detectable in thin section include: algal breccia and pellet-ostracode infill, ruptured and redistributed pellet-ostracode layers, and interrupted laminae. One slide showed nine major growth cycles. Digitation was probably caused by rupture of the algal mat with subsequent filamentous growth inhibited in the damaged, interdigital areas. Numerous plant spores, incorporated in the growing algae, are found aligned with growth laminae. Colorimetric determinations of phosphate contents of fossil and modern algae suggest a possible method for discriminating fresh- and brackish-water from marine algae. — VMJ

Taylor, Hugh P., Jr. *See* O'Neil, James R. 06279

05765 **Taylor, L. A.** The significance of twinning in Ag_2S: Am. Mineralogist, v. 54, nos. 5-6, p. 961-963, table, 1968.

Twinning in Ag_2S is observed to form, on heating, well below the 177°C inversion from low-temperature Ag_2S, acanthite, to the high-temperature form, argentite. This twinning, premonitory of theinversion, is preserved upon subsequent cooling to room temperature. Therefore, the presence of twinning in Ag_2S cannot be used as a minimum-temperature indicator; the high-temperature crystal structure may never have existed. — Author's abstract

06094 **Tedrow, J. C. F.** Thaw lakes, thaw sinks and soils in northern Alaska: Biul. Peryglacjalny, no. 20, p. 337-344, illus., 1969.

Most of the thaw lakes and thaw sinks in the eolian silts south of Umiat have been partly drained, through headward erosion, thawing of permafrost, and filling. The exposed lake floors are levelled in 1- to 5-ft steps, the result of a complex of downcutting of drainage channels and collapse of underlying ground, with erosion and filling along the lake margins. Two C-14 dates from buried organic matter in the eolian silts yielded ages of 9325 and 9130 yr B.P.; one date from a depth of 5 feet in the highest exposed lake floor gave an age of 4590 yr B.P. Whereas the original eolian silts were once virtually organic-free, the lake-floor sediments contain considerable organic matter mixed throughout the substrate and increasing in the lower lake-floor levels; this is reflected in the soil morphology. — *from* Author's abstract

06156 **Terasmae, Jean.** Quaternary palynology in Quebec — A review and future prospects [with French and German abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 281-288, illus., tables, 1969.

Quebec was the birthplace of Canadian Quaternary palynology, the early studies being directed toward peat investigations, and from this, pollen stratigraphy, climatic studies, and vegetational history were realized. In the 1950's several major projects were initiated, and with the help of radiocarbon dating, palynology became even more useful for geological investigations. However, to date, palynology is still in its preliminary stages in Quebec and the greatest current needs are training of palynologists and provision of financial assistance for basic studies. A summary of needs and priorities in Quaternary palynology is given in the last part of this review. — *from* Author's abstract

06075 **Terrell, John Upton.** The man who rediscovered America — A biography of John Wesley Powell: New York, Weybright and Talley, 279 p., illus., 1969.

06358 **Thom, Bruce G.** New permafrost investigations near Schefferville, P.Q. [with French and German abs.], *in* Le Quaternaire du Québec: Rev. Géographie Montréal, v. 23, no. 3, p. 317-327, illus., table, 1969.

The discontinuous nature of permafrost distribution is most apparent. There appears to be a very close relationship between winter snow cover and the occurrence of permafrost. Wind-swept ridge crests possessing snow cover of 60 cm and less are commonly underlain by permafrost; here the vegetation is sparse with no scrub or tree growth. In contrast, low relief valleys and adjacent slopes, which are poorly drained and covered by scrub or hygrophytic plants and one meter or more of winter snow, are areas which either lack permafrost or have ground temperatures just below 0°C. In the latter case isotherms are typically vertical indicating proximity to a cold core beneath a ridge crest. It is estimated that permafrost extends to a depth of plus 90 meters beneath the coldest portion of the area, the southern end of Timmins I mine. — *from* Author's abstract

Thomaidis, N. D. *See* Keller, E. R. 06225

05961 **Thomas, Josephus, Jr.; Bohor, Bruce F.** Surface area of vermiculite with nitrogen and carbon dioxide as adsorbates [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 4, p. 205-209, illus., table, 1969.

Studies on several homoionic vermiculites with nitrogen and carbon dioxide adsorbates show only slight penetration between individual platelets, in contrast to montmorillonite [ibid., v. 16, p. 83-91] where it was quite high and governed by size and charge of the interlayer cation. Inability of these adsorbates to penetrate between vermiculite platelets is due primarily to high surface-charge density; the extent of their slight penetration at edge of the platelets is influenced by the coordinated water retained within sample at a given degassing temperature, as forces between layers are weakened with increasing water content. Thus, the surface area of vermiculite, as determined by gas adsorption, is larger than calculation based on particle size and shape; lifting and scrolling of terminal platelets provide extra surface. These morphological features are shown in scanning electron micrographs of natural vermiculite. — *from* Authors' abstract

Thomas, Josephus, Jr. *See* Leamnson, R. N. 06078

05817 **Thompson, J. B., Jr.; Waldbaum, D. R.** Mixing properties of sanidine crystalline solutions — [Pt.] 3, Calculations based on two-phase data: Am. Mineralogist, v. 54, nos. 5-6, p. 811-838, illus., tables, 1969.

Analytic expressions for the solvus bounding a binary two-phase region may be obtained using observed pairs of coexisting phases by plotting appropriate functions of compositions against reciprocal temperature and to obtain Margules parameters by linear least-squares fits to the values plotted, or by making use of near-linear relations in the critical region between the square of difference in composition of the two phases, mean composition, and reciprocal temperature. The second method is preferable for some data since it completely separates mean composition and composition difference. Both show that three sets of two-feldspar data obtained by using different starting materials yield distinctive binodal curves. Results are consistent with the hypothesis that feldspars crystallized in the presence of excess alkali show the least substitution of hydronium for alkali. — *from* Authors' abstract

05810 **Thompson, T. D.; Brindley, G. W.** Absorption of pyrimidines, purines and nucleosides by Na-, Mg-, and Cu(II)-illite (Clay-organic studies. XVI): Am. Mineralogist, v. 54, nos. 5-6, p. 858-868, illus., 1969.

Illite from Skytop, Pa., was treated to remove contaminants and a <1 micron fraction was separated. The cation exchange capacity of this fraction was 0.14 ± 0.01 meq/g illite and the surface area measured was 65 m^2/g. With Na- and Mg-saturated illite, organic absorption occurs mainly under acid conditions by cation exchange. The pH of the equilibrating solution for maximum absorption shows a linear relationship to pK_a for formation of protonated molecules. Maximum absorption of different molecules diminishes as pK_a diminishes and as more acid conditions are required for protonation. With Cu(II)-saturated illite, a cation exchange process operates at low pH values, complex formation occurs between organic molecules and Cu(II) ions, and percentage absorption is related to electron releasing ability of the substituent groups attached to purine and pyrimidine bases. — *from* Authors' abstract

06079 **Thorpe, A. N.; Senftle, F. E.; Donnay, G.** Magnetic susceptibility and exchange coupling in the mineral ardennite: Jour. Physics and Chemistry Solids, v. 30, no. 9, p. 2235-2239, illus., table, 1969.

Ardennite, a rare silicate mineral, contains about 19 wt percent manganese. Some of the manganese atoms are in positions which are close enough to allow negative exchange and hence a reduction of the total magnetic susceptibility. It is shown that the susceptibility can be accounted for approximately by the treatment of Earnshaw and Lewis (1968) for S = 5/2 and a Hamiltonian $H = -2g\mu H_z - 2JS_1 \times S_2$. — Authors' abstract

Thro, P. *See* Maurette, M. 05861

05855 **Thurmond, John T.** New name for the mosasaur *Compressidens* Dollo, 1924: Jour. Paleontology, v. 43, no. 5, p. 1298, 1969.

The new generic name *Carinodens* is proposed to replace *Compressidens* Dollo, 1924, which is preoccupied by the subgeneric name *Compressidens* Pilsbry and Sharp, 1897, for a scaphopod. — FCW

06019 **Thurston, P. C.; Carter, M. W.** Operation Fort Hope — Lansdowne House-Fort Hope sheet, Districts of Kenora (Patricia Portion), Thunder Bay, and Cochrane: Ontario Dept. Mines Prelim. Geol. Map P. 562, scale 1 in. to 2 mi., 1969.

06020 **Thurston, P. C.; Carter, M. W.** Operation Fort Hope — Attawapiskat River sheet, Districts of Kenora (Patricia Portion), and Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 563, scale 1 in. to 2 mi., 1969.

06021 **Thurston, P. C.; Carter, M. W.; Riley, R. A.** Operation Fort Hope — Attwood-Caribou Lakes sheet, Districts of Kenora (Patricia Portion), and Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 564, scale 1 in. to 2 mi., 1969.

06022 **Thurston, P. C.; Carter, M. W.** Operation Fort Hope — Makokibatan-Melchett Lakes sheet, Districts of Kenora (Patricia Portion), Cochrane, and Thunder Bay: Ontario Dept. Mines Prelim. Geol. Map P. 565, scale 1 in. to 2 mi., 1969.

05965 **Tien, Pei-Lin.** A purple-colored 1M mica clay from Silverton, Colorado [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 4, p. 245-249, illus., tables, 1969.

A purple-colored clay of 1 M mica polymorph in association with lead-zinc ore was collected from an abandoned mine dump near Silverton, Colorado. Electron micrographs show that the crystallites of the clay are less than 2μ in size and have poorly developed hexagonal outlines. Differential thermal and i.r. absorption analyses indicate similarity with those of muscovite. The structural formula of the 1 M mica polymorph is $(K_{1-.85}Na_{0-.02})(Al_{2-.75}Mg_{0-.19})(Si_{3-.00}Al_{1-.10})O_{20}(OH)_4$. The purple color may be related to trace amounts of manganese in the clay. — Author's abstract

06241 **Tilgner, Edward E.; Peterson, Jon R.** The Alaska Tsunami Warning System, *in* The Prince William Sound, Alaska, earthquake of 1964 and aftershocks, V. 2: U.S. Coast and Geod. Survey Pub. 10-3, v. 2, pts. B-C, p. 309-324, illus., tables, 1969.

The basic system concepts and the instrumentation used in the initial installation of the Alaska Tsunami Warning System are described. The warning system is now in operation and is designed to provide tsunami warnings on the basis of seismic data within 15 minutes of the occurrence of any large earthquake in the Alaska-Aleutian Islands area. — KAF

05919 **Timmerman, David Harold.** Deformation characteristics of sand subjected to anisotropic cyclic dynamic loading [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1674B-1675B, 1969.

Tobailem, J. *See* Cantelaube, Y. 05830

Todd, Robert G. *See* Silver, Burr A. 05674

Tokonami, Masayasu. *See* Morimoto, Nobuo. 05822

Tokonami, Masayasu. *See* Morimoto, Nobuo. 06069

Troup, Arthur G. *See* Harriss, Robert C. 06060

06057 **Trueb, Lucien F.; deWys, E. Christian.** Carbonado — Natural polycrystalline diamond: Science, v. 165, no. 3895, p. 799-802, illus., table, 1969.

Carbonados are porous aggregates of mostly xenomorphic diamond crystallites ranging in diameter from a fraction of a micron to over 20 microns. Crystalline inclusions (up to 3 percent) occur in the pores of the crystallites and consist mainly of orthoclase and small amounts of other igneous, metamorphic, and secondary minerals. — Authors' abstract

Tryggvason, Eysteinn. *See* Lawson, J. E., Jr. 05895

05847 **Turner, G.** Thermal histories of meteorites by the ^{39}Ar-^{40}Ar method, Paper 34 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 407-417, illus., tables; discussion, p. 460-461, 1969.

The application of the Ar-39-Ar-40 method to meteorites is considered and results of recent investigations of both low- and high-age hypersthene chondrites are discussed in terms of current theories of origin. Applied to the high-age chondrites the method yields lower limits for parent-body cooling rates which do not conflict with estimates by other techniques [and are consistent with fairly rapid cooling of parent body]; greater accuracy would be required to actually measure these cooling rates. In addition it is possible to obtain what are probably the only unambiguous and accurate high K-Ar ages, unaffected by uncertainties of argon loss. A comparison of these

measurements for different meteorites may provide information about temperature distribution within the parent. — *from* Author's abstract

05730 **Uhlig, H. H.; Duquette, D. J.** Origin of the eutectoid structure in Canyon Diablo [abs.]: Meteoritics, v. 4, no. 3, p. 208-209, 1969.

Ulrichs, Juris. *See* Campbell, Malcolm J. 06284

Untermann, B. R. *See* Untermann, G. E. 06224

Untermann, B. R. *See* Untermann, G. E. 06237

06224 **Untermann, G. E.; Untermann, B. R.** From Mancos to Mancos across the Uintas (Vernal to Manila), *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 221-225, illus., 1969.

This is an account of the geology along the roads from Vernal to Manila, Utah, across the Uinta Mountains. The geology along the way is described from specified stops, marked by highway signs. The route is from Vernal northward on Route 44 to the Flaming Gorge reservoir, and thence via Sheep Creek to Manila. No mileage is cited, but the descriptions make the positions of stops clear. — HRC

06237 **Untermann, G. E.; Untermann, B. R.** Geology of the Uinta Mountain area, Utah-Colorado, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 79-86, illus., 1969.

A generalized account of the geology of the Uinta Mountain region is given. Most of the rocks are sedimentary, ranging in age from Precambrian to Cretaceous. Uplift and folding began within the Upper Cretaceous, and a second event occurred in the Eocene. The final diastrophic events appear to have been continental uplifts in the Pliocene, amounting to possibly 8,000 to 10,000 feet, which includes the formation of the Uinta graben. Glacial erosion has sculptured the present range, after considerable erosion had occurred. — HRC

06074 **U.S. Army Corps Engineers.** Bibliography on cold regions science and technology, V. 23: U.S. Army Corps Engineers Cold Regions Research and Eng. Lab. CRREL Rept. 12 (v. 23), unpaged, 1969.

The bibliography consists of two volumes — one the bibliography proper and the other the author and subject indexes. Material accessioned between November 1967 and June 1969 totals 5,310 citations. — MCM

06109 **U.S. Atomic Energy Commission; U.S. Geological Survey.** Preliminary reconnaissance for uranium in Connecticut, Maine, Massachusetts, New Jersey, New York and Vermont, 1950 to 1959 — U.S. Atomic Energy Comm. [Rept.] RME-4106: Washington, D.C., U.S. Govt. Printing Office, 129 p., 1969.

For the preliminary reconnaissance reports, information is given on location of property, radioactivity, geology, directions to property, owner, lessee or contacts, and references. Trace element reports include also mine workings, type of examination, whether or not deposit is radioactive, type and age of deposit, attitudes, and sample information. — MCM

06092 **U.S. Geological Survey.** Aeromagnetic map of the Harrisburg-Scranton area, northeastern Pennsylvania: U.S. Geol. Survey Geophys. Inv. Map GP669, scale 1:250,000, 1969.

U.S. Geological Survey. *See* U.S. Atomic Energy Commission. 06109

06041 **Usik, Lily.** Botanical investigations at three known mineral deposits: Canada Geol. Survey Paper 68-71, 32 p., illus., tables, 1969.

Identification and systematic investigations of the distribution and morphological features of about 165 plant species at two copper properties and one molybdenum property in British Columbia did not reveal the presence of any plants indicative of ore minerals. Distribution of plant species and the general vitality of the growth of the plants were related to qualities of site, i. e. drainage, soil, relief, and to region. Lupine concentrated molybdenum in much larger amounts than lodgepole pine. However, only the Cu:Zn ratio of the lupine outlined reasonably well the presence of copper-bearing rocks at one property. No relationship could be established between growth swellings in the trunks of alpine fir and the presence of mineralized rocks or any other environmental factor at the molybdenum property. — Author's abstract

Utah Geological Society. *See* Intermountain Association of Geologists. 06253

06015 **Vallentyne, J. R.** Pyrolysis of amino acids in Pleistocene *Mercenaria* shells: Geochim. et Cosmochim. Acta, v. 33, no. 11, p. 1453-1458, illus., tables, 1969.

The order of increasing stability of amino acids in pyrolysed shells of *Mercenaria* (174°-252°C) is given. The rates of decomposition were all greater than for the same amino acids alone in dilute aqueous solution. — KAF

05949 **VanDeBraaff, Fredric Ray.** Depositional environments and petrology of the Castlegate Sandstone (Cretaceous), east-central Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1760B, 1969.

06217 **VanFossen, Gordon W.** Economics of Minnelusa production in the northern Powder River basin, *in* Eastern Montana symposium — Montana Geol. Soc., 20th Ann. Conf. 1969: Billings, Mont., Montana Geol. Soc., p. 71-75, illus., table, 1969.

Some suggested guidelines to economical Minnelusa exploration and development are: (1) Drill prospects with adequate subsurface control. (2) Analyze the economic potential of the prospective reservoir as to size and to possible thickness to insure adequate return on investment. (3) Properly drill-stem-test all oil-stained Minnelusa reservoirs (only if at least 4 bbl/hr, and regrain from sand fracturing or acidizing to make a marginal well a producer). (4) Proceed slowly with development drilling while carefully noting production performance of producing wells. (5) Repeat (2) as each well is drilled to insure continued economic exploration of reservoir. (6) Avoid drilling unnecessary dry holes through careful analysis of production and DST data. — *from* Author's guidelines

06129 **VanHoeven, William; Maxwell, J. R.; Calvin, Melvin.** Fatty acids and hydrocarbons as evidence of life processes in ancient sediments and crude oils: Geochim. et Cosmochim. Acta, v. 33, no. 7, p. 877-881, illus., 1969.

Analyses of several ancient sediments and oils for fatty acids reveal that the even/odd predominance of n-acids can be preserved throughout geological time. N-alkanes from the same samples do not arise from the n-fatty acids solely by decarboxylation. An abiological or recent bacterial origin of the acids is considered. — Authors' abstract

06049 **VanHouten, F. B.** Molasse facies — Records of worldwide crustal stresses: Science, v. 166, no. 3912, p. 1506-1508, illus., 1969.

Predominantly nonmarine molasse deposits in the Tethyan and Cordilleran mobile belts record major variations in orogenic activity in latest Cretaceous to earliest Cenozoic, mid-Cenozoic, and latest Cenozoic time. During the same intervals changes in activity also occurred on the sea floor. This coincidence suggests worldwide effects of movement of crustal plates. — Author's abstract

06196 **VanHouten, F. B.** Late Triassic Newark Group, north central New Jersey and adjacent Pennsylvania and New York, Field Trip 4 *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol.Soc.America, Ann.Mtg., Atlantic City, 1969: New Brunswick,N.J., Rutgers Univ.Press, p. 314-347, illus., table, 1969.

In the largest of six major Triassic rift valleys in a sinuous belt of 1,000 mi between Nova Scotia and Florida are the Newark Group's 16,000-20,000 feet of nonmarine sedimentary rocks and associated basic sills and flows. The basin is 140 mi long from Rockland County, N.Y. to Lancaster County, Pa. and a maximum 32 mi wide along the Delaware River; rocks dip 10-20° NW and strike SW. Bounded mostly by high-angle faults and offset at the south, Triassic strata within the basin lie on Paleozoic and subordinate Precambrian rocks, intermittently overlap them on the Highlands and Piedmont, and are overlapped by Cretaceous and younger coastal plain deposits. Newark strata are locally folded and faulted; petrologic and stratigraphic descriptions are summarized. The field trip crosses the basin along the Delaware River, runs northeast to Nyack, N.Y., and south on the Palisades to New Brunswick. — GDC

05731 **VanSchmus, W. R.** Type III carbonaceous chondrites and metamorphism [abs.]: Meteoritics, v. 4, no. 3, p. 210-211, 1969.

05851 **VanSchmus, W. R.** Mineralogy, petrology, and classification of types 3 and 4 carbonaceous chondrites, Paper 39 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 480-491, illus., tables; discussion, p. 534, 1969.

Petrographic and microprobe analyses on Types 3 and 4 carbonaceous chondrites reveal two subtypes, called Vigarano and Ornans subtypes. The most diagnostic distinction between them is textural. The Vigarano has large 'spongy' chondrules embedded in an abundant, fine-grained, opaque matrix; chondrules contain numerous spheroidal droplets of Ni-Fe or sulfide. Ornans subtype has a close-packed aggregate of small, metal-poor chondrules with fine-grained, opaque matrix packed between chondrules. There is evidence for a trend toward homogeneity of mineral compositions in both, analogous to unequilibrated ordinary chondrites. Vigarano subtype may have a factor of 2 or more carbon and water than Ornans, while the latter may be richer in primordial rare gases. Kainsaz, Ornans, Lance, Felix, and Warrenton belong to Ornans, and Grosnaja, Vigarano, Efremovka, and Coolidge to Vigarano. — VSN

06046 **VanValen, Leigh.** Climate and evolutionary rate: Science, v. 166, no. 3913, p. 1656-1658, illus., 1969.

Stehli, Douglas, and Newell (1969) have proposed that evolutionary rates tend to be greater in tropical areas than in temperate ones. An analysis of the major tropical and north temperate faunas of recent mammals shows no tendency for tropical families of mammals to be older than temperate families; in fact the reverse is ostensibly true. It is the rate of origination in each climate that is relevant, and our knowledge of the area of origin of most families is too poor to study this rate directly. The existence of climatic differences in evolutionary rates has not yet been adequately shown. — DBV

06085 **Varnes, David J.** Stability of the west slope of Government Hill, port area of Anchorage, Alaska: U.S. Geol. Survey Bull. 1258-D, p. D1-D61, illus., tables, 1969.

Government Hill, rising 100 feet above an industrial and port area built on a tidal flat, is capped by 35-45 feet of sand and gravel underlain by Bootlegger Cove Clay. Almost continuous old landslides form the west- and northwest-facing slopes. Slope-stability safety factors were computed in the vicinity of two lines. Under static conditions the slope at line 1 seems to be stable so long as line 2 verges on failure along an assumed circular arc. Under seismic conditions both slopes appear susceptible to failure along flat zones in the Bootlegger Cove Clay. No major slope failure in the vicinity of lines 1 and 2 accompanied the 1961 earthquake. Further industrial development should proceed with caution. — DJV

06195 **Vedder, J. G.; Wagner, H. C.; Schoellhamer, J. E.** Geologic framework of the Santa Barbara Channel region,Chap. A *in* Geology, petroleum development, and seismicity of the Santa Barbara Channel region, California: U.S. Geol. Survey Prof. Paper 679, p. 1-11, illus., geol. map, 1969.

The Santa Barbara Channel region, the westernmost part of the Transverse Range province of southern California, includes the Santa Ynez Mountains to the north and the Channel Islands to the south; Point Conception and San Miguel Island are near the west margin and the town of Ojai and Hueneme Canon near the east edge. The province is the partly submerged extension of the Ventura basin, a topographic and structural depression with more than 50,000 feet of Cretaceous and Tertiary strata. Bordering ranges and islands are complexly folded and faulted sedimentary and igneous rocks underlain by a basement complex partly equivalent to that exposed in high ranges to the east. The stratigraphy, generalized structure, and geologic history are summarized; selected stratigraphic sections, and onshore and interpretative subbottom structure sections are included. — VSN

Verma, R. K. *See* Hamza, V. M. 06104

06351 **Versey, H. R.** Thermal and mineral springs of Jamaica, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc. Symposium 2, Mineral and thermal waters of the world — [Pt.] B, Oversea countries (Rept., V. 19): Prague, Academia, p. 265-268, illus., table, 1969.

Thermal springs are few in Jamaica, where the youngest volcanism is Pliocene in age. The five thermal and three nonthermal springs are described briefly, and chemical analyses are given for six of them. — DBV

Vilcsek, E. *See* Begemann, F. 05844

Vilcsek, E. *See* Begemann, F. 06330

Viljoen, Morris J. *See* Anhaeusser, Carl R. 05884

Viljoen, Richard P. *See* Anhaeusser, Carl R. 05884

von Michaelis, H. *See* Ahrens, L. H. 05869

05957 **Voorhies, Michael R.** Taphonomy and population dynamics of an early Pliocene vertebrate fauna, Knox County, Nebraska: Wyoming Univ. Contr. Geology Spec. Paper 1, 69 p., illus., tables, 1969.

A bone bed in the Valentine formation at Verdigre quarry has yielded over 20,000 specimens representing about 40 genera of mammals (large ungulates numerically predominant), 7 of reptiles, 2 of amphibians, and 6 of fishes, from a lens of very poorly sorted alluvium deposited probably by a single flood in a depression on a broad floodplain. Disarticulation, abrasion, and selective current sorting of bones indicate that most of the animals died prior to the flood. Distribution of age groups, based on tooth wear, indicate that the large grazing mammals, *Protohippus* and *Merycodus* at least, died a nonselective catastrophic death in the winter, presumably when they sought shelter or water on the wooded floodplain, away from their preferred interstream habitat. Winterkilling of fishes, also, is indicated in growth rings of vertebrae and scales. — VMJ

Wagner, H. C. *See* Vedder, J. G. 06195

Wagner, H. C. *See* Yerkes, R. F. 06364

05732 **Wai, C. M.; Wasson, J. T.** Silicon in iron meteorites and in the metal phase of enstatite achondrites [abs.]: Meteoritics, v. 4, no. 3, p. 212, 1969.

Waldbaum, D. R. *See* Thompson, J. B., Jr. 05817

06017 **Waldbaum, D. R.** Thermodynamic mixing properties of NaCl-KCl liquids: Geochim. et Cosmochim. Acta, v. 33, no. 11, p. 1415-1427, illus., tables, 1969.

The excess Gibbs energies and entropies of mixing of NaCl-KCl liquids have been calculated using previously derived mixing parameters of the crystalline solutions

and the temperature and composition of the minimum in the melting region. Margules parameters of the liquid based on the present formulation differ by 1 kcal at 800°C from the values obtained in electrochemical studies. Solidus and liquidus curves calculated from these results are compared with experimental data from 12 previous studies of the melting region. Alkali buffer potentials were calculated from the mixing properties of the liquid. — *from* Author's abstract

06250 **Walker, H. J.; McCloy, J. M.** Morphologic change in two arctic deltas — . . . Blow River delta, Yukon Territory, and Colville River delta, Alaska — U.S. Army Research Office Contract DAHCO4-67C-0061, Final Rept.: Arctic Inst. North America Research Paper 49, 91 p., illus., tables, 1969.

The drainage basin of each river is confined to the Arctic Slope. Morphologic change is the result of integration of a variety of processes, some of which do not operate in temperate or tropical deltas. Ice and snow are passive agents during most of the time they are present, but the erosional, transportational, and depositional effectiveness of ice may be great. However the most important agent in deltaic change is flowing water which begins to operate once flow onto and over ice is initiated. Permafrost, present except beneath the largest lakes, greatly influences erosion. Banks [composed of thick layers of dense peat] may retreat gradually or by the sudden collapse of blocks undercut by as much as eight meters. Morphologic change in arctic deltas tends to be concentrated in a short period of time centered around breakup. — *from* Authors' abstract

06350 **Walker, Kenneth R.** The Palisades sill, New Jersey — A reinvestigation: Geol. Soc. America Spec. Paper 111, 178 p., illus., tables, 1969.

The sill, emplaced in the Newark Formation in Late Triassic, and about 1000 feet thick, is a multiple intrusion in which two magma phases of over-saturated tholeiite are recognized. The order in which essential minerals began to crystallize in each phase was olivine, plagioclase, augite, and orthopyroxene. In the north where the Mg-olivine layer is absent, contact between the magmas is marked by reversal in pyroxene fractionation trend. Fractional crystallization dominated differentiation, and progressive crystallization proceeded to a stage where fayalite granophyre and granophyric dolerite formed. Element behavior with fractionation was determined by studying variations of 18 metals in the rock and mineral series which arrange themselves in lattice sites during fractional crystallization according to total chemical properties. Properties of the ion in crystal lattice as well as in liquid determine its behavior. — *from* Author's abstract

05985 **Walker, L. K.; Raymond, G. P.** Anisotropic consolidation of Leda clay [with French abs.]: Canadian Geotech. Jour., v. 6, no. 3, p. 271-286, illus., tables, 1969.

Consolidation of a clay layer is likely to occur under principal stress ratios varying from point to point. From idealized stress paths, an estimate is made of effect of stress ratio on rates of volumetric strain and excess pore water pressure dissipation; predictions are partly supported by data obtained from anisotropic consolidation tests on Leda clay, major disagreements being due to influence of structural cementation. Experimentally observed rates of shear strain have been analyzed in terms of stress-dilatancy concepts. The plastic strain-increment ratio was shown to be a unique function of effective stress ratio, confirming validity of previous work on remoulded clays. Theoretical prediction of this relation (Burland, 1965) did not approximate experimental data, due to secondary deformations. Data did show a relation similar to that for secondary deformation of remoulded kaolin. — *from* Authors' abstract

Walker, R. *See* Maurette, M. 05861

Walker, R. *See* Shirck, J. 05873

05733 **Walker, Walter W.** The original location of the Tucson irons [abs.]: Meteoritics, v. 4, no. 3, p. 212, 1969.

06354 **Wallace, Chester A.; Crittenden, Max D., Jr.** The stratigraphy, depositional environment and correlation of the Precambrian Uinta Mountain Group, . . ., *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 127-141, illus., 1969.

This 26,000-ft thick section underlies unconformably the Cambrian Tintic Quartzite; its base is unknown. Six different clastic units are recognized, and these are overlain by the uppermost Red Pine Shale. The various units are intertongued in such a way that a tentative stratigraphic and sedimentary environmental interpretation can be made. Fluvial-floodplain, paralic-neritic "marine", and deltaic environments are recognized, and the Red Pine Shale is of uncertain origin. A major transgression from north to south into a shallow water basin is indicated, with a west trending fluvial system entering the basin from the east, and with a delta complex on the west. The final deposition was that of a starved basin. Provenance was to the north and east in an area of high relief, dry, arid, and cold. The basin opened to the southwest. — HRC

06172 **Waller, Thomas R.** The evolution of the *Argopecten gibbus* stock (Mollusca:Bivalvia), with emphasis on the Tertiary and Quaternary species of eastern North America: Paleont. Soc. Mem. 3 (Jour. Paleontology, v. 43, no. 5, supp.), 125 p., illus., tables, 1969.

A study of the morphology and ecology of living taxa (three Atlantic and two Pacific species) deduced from population samples is applied to the interpretation of samples of fossil populations collected from upper Cenozoic strata (Alum Bluff Group of middle Miocene through Pleistocene) exposed on the Atlantic and Gulf Coastal Plains of the United States. Cenozoic phylogeny, involving 14 species and several subspecies, is postulated. Evolution of the stock apparently has been faster on the Atlantic side of the Americas than on the Pacific side, with living Pacific species resembling late Miocene and early Pliocene Atlantic species. Several nomenclatural changes are made. — RCD

05898 **Walter, Edward J.** Focal depth of central United States earthquakes [abs.]: Earthquake Notes, v. 40, no. 2, p. 15, 1969.

05679 **Walters, Richard F.** Contouring by machine — A user's guide: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2324-2340, illus., 1969.

Machine contouring should never be used for one-pass jobs, or where data control points are sparse or widely spaced, or if interpretations depend partly upon scientific bias. Machine contouring should be used to analyze voluminous (geochemical) data to establish significant parameters, or to update a map series, or to prepare a series of internally consistent maps where, for example, structure surface "A" plus isopach equals structure surface "B". Steps in map generation are (1) map specification, (2) data input, (3) grid generation from irregularly-spaced points, (4) contour-line generation, and (5) special annotation and optional operations. Each step is described and illustrated by practical applications. — BHK

Walthall, F. G. *See* Helz, A. W. 06123

05682 **Walton, Kenneth.** The arid zones: Chicago, Ill., Aldine Publishing Co., 175 p., illus., 1969.

This worldwide treatment of arid zones contains chapters on: nature and causes of aridity, climates of arid lands, desert landscapes, biogeography of arid lands, water resources of arid lands, cultivation in dry lands, pastoralism (a basic dry-land response), and future of dry lands. An eight-page bibliography and a subject index are included. — MCM

Wänke, H. *See* Chang, C. 05846

Wänke, H. *See* Quijano-Rico, M. 05867

Wänke, H. *See* Begemann, F. 05981

Wänke, H. *See* **Rieder, R. 06327**

Wänke, H. *See* **Begemann, F. 06330**

Warkentin, B. P. *See* **Yong, R. N. 06298**

06143 **Warren, Andrew.** A bibliography of desert dunes and associated phenomena, *in* Arid lands in perspective (W. G. McGinnies and B. J. Goldman, editors): Washington, D.C., Am. Assoc. Adv. Sci., and Tucson, Ariz., Univ. Arizona Press, p. 75-99, 1969.

This bibliography is biased toward the United States and the Sahara; coastal dunes are not included. Of articles published before 1920, there are 99 entries listed alphabetically; from 1920 to 1939 there are 125; from 1940 to 1959, 224; from 1960 to 1967, 168. A special bibliography of sand movement by wind, with titles listed alphabetically until 1967, has 58 entries; a bibliography of studies of aeolian sand (until 1967) has 134 items. No index is included. — HRC

05850 **Wasserburg, G. J.; Burnett, D. S.** The status of isotopic age determinations on iron and stone meteorites, Paper 38 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 467-479, illus., table; discussion, p. 534, 1969.

A discussion of the ages determined by various methods is given. The results of Rb-87/Sr-87 and K-400/Ar-40 ages on the silicate phases of iron meteorites are summarized as well as the internal isochrons on stone meteorites. The data for Kodiakanal are reviewed and the importance of recognizing events of intermediate age in the formation of planetary objects is emphasized. It is shown that it is possible to resolve time events by high precision Sr measurements to 5×10^7 years for chondrites. — Authors' abstract

05908 **Wasserburg, G. J.; Papanastassiou, D. A.; Sanz, H. G.** Initial strontium for a chondrite and the determination of a metamorphism or formation interval: Earth and Planetary Sci. Letters, v. 7, no. 1, p. 33-43, illus., table, 1969.

A precise Rb-Sr internal isochron was determined for Guarena, an H6 chondrite, yielding an age of $4.56 \pm 0.08 \times 10^9$ years. Rb-poor, Sr-rich phosphate phases (whitlockite and apatite) obtained resulted in precise measurement of the initial Sr isotopic composition $(Sr\text{-}87/Sr\text{-}86)_I = 0.69995 \pm 0.00015$. It is shown that from precise age and initial $(Sr\text{-}87/Sr\text{-}86)_I$ measurements we can obtain information on the differential evolution of Rb-Sr systems involving either simple metamorphism of closed systems or multistage processes. The high initial ratio obtained for Guarena with respect to the value for basaltic achondrites is the first clear demonstration of differential Sr evolution of a chondrite and affords the simple explanation of Guarena having been metamorphosed 74 million years after its formation. This approach may yield a "time" evolution index for the classification of meteorites. — Authors' abstract

Wasserburg, G. J. *See* **Steiger, R. H. 06173**

Wasson, J. T. *See* **Wai, C. M. 05732**

05700 **Wasson, John T.; Kimberlin, Jerome.** The Needles (California) iron meteorite: Meteoritics, v. 4, no. 3, p. 233-239, illus., 1969.

The Needles fine octahedrite, which weighs 45.3 kg, was found in 1962 in the Turtle Mountains, about 50 km SSW of Needles, Calif. It contains 10.3 percent Ni, 77 ppm Ga, 93 ppm Ge and 4.8 ppm Ir, and is a member of chemical group II D. It is rather similar to the Wallapai, Arizona, meteorite, and may possibly be a transported mass from this multiple fall. The compositional evidence slightly favors the interpretation that Needles is a distinct fall. — Authors' abstract

06133 **Wasson, John T.** The chemical classification of iron meteorites — [Pt.] 3, Hexahedrites and other irons with germanium concentrations between 80 and 200 ppm: Geochim. et Cosmochim. Acta, v. 33, no. 7, p. 859-876, illus., tables, 1969.

Concentrations of Ni, Ga, Ge, and Ir are reported for 61 iron meteorites having Ge concentrations between 80 and 200 ppm. Characteristics of four additional chemical groups are tabulated. — KAF

05795 **Waterhouse, J. B.** Growth lamellae on the type species of the upper Paleozoic bivalve *Aviculopecten* M'Coy: Jour. Paleontology, v. 43, no. 5, p. 1179-1183, illus., 1969.

Growth lamellae on the left valve of the type species of *Aviculopecten* M'Coy are shown to swing ventrally in interspaces between costae, not dorsally as stated by Newell (1938). Therefore the genus is possibly closely allied to *Limipecten* Girty (1904). Some of the species referred by Newell (1938) to *Aviculopecten* should be reassigned to *Heteropecten* Kegel and Costa (1951) and some of the others to *Etheripecten* Waterhouse (1963). — Author's abstract

05781 **Webb, M. Dean.** Stratigraphic control of sandstone uranium deposits in Wyoming, *in* Wyoming uranium issue: Wyoming Univ. Contr. Geology, v. 8, no. 2, pt. 1, p. 121-129, illus., 1969.

Observed and conceived relationships of rock facies to uranium ore occurrences are integrated into a sedimentary model in which uranium is commonly deposited. Later a microbiological, geochemical, and ore depositional model is placed into the larger sedimentary model. In Wyoming the locations of uranium deposits are controlled by distribution of carbonaceous debris in permeable sandstones, interbedded with siltstones and mudstones, along paleostream margins. Both uranium and favorable sediments were derived from crystalline source rock of the uplifts. During compaction and erosion, uranium was leached from the sediments by cold connate, phreatic, and vadose waters. Bacteria living on the carbonaceous substrate played a major role in deposition of uranium. — ESL

06119 **Webb, S. Donald.** A proposito de la edad de las rocas de las colinas de Samalayuca, noreste de Chihuahua: Soc. Geol. Mexicana Bol. 1967, v. 30, no. 2, p. 155-157, 1969.

Rocks of the Sierra de Samalayuca and surrounding hills, northeastern Chihuahua, have been reported by various authors as Precambrian, Paleozoic or Mesozoic. Rocks of the surrounding hills contain ammonites, but those of the anticline have only an occasional pelecypod. The pelecypods do indicate that the age is not Precambrian. The ammonites have been assigned a Neocomian age by Keith Young, University of Texas, and the rocks should be assigned an Early Cretaceous age. — VSN

Webbink, R. *See* Maurette, M. 05861

Weber, H. *See* Hintenberger, H. 05922

06175 **Wellman, Thomas R.** The vapor pressure of NaCl over decomposing sodalite: Geochim. et Cosmochim. Acta, v. 33, no. 10, p. 1302-1304, illus., 1969.

An equation is given which describes the vapor pressure of NaCl over synthetic sodalite at its breakdown to nepheline as determined by a dew point method. The heat of incongruent vaporization for sodalite is 86.5 kcal per mole NaCl. — GV

05951 **Wellman, Thomas Robert.** The stability of sodalite in the system $NaAlSi_3O_8$-KAlSi_3O_8-$NaAlSiO_4$-$KAlSiO_4$-NaCl-KCl-H_2O [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1761B, 1969.

West, Gordon F. *See* Dunlop, David J. 06188

Wetherill, G. W. *See* Gopalan, K. 05707

05735 **Wetherill, G. W.** Possible equivalence of Prairie network fireballs and chondrites [abs.]: Meteoritics, v. 4, no. 3, p. 214, 1969.

05839 **Wetherill, G. W.** Relationships between orbits and sources of chondritic meteorites, Paper 48 *in* Meteorite research(P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 573-589, illus.,; discussion, p. 625-627, 1969.

A Monte Carlo method, based on that of Arnold, is used to calculate the way in which initial meteorite orbits evolve with time and to find the predicted distribution of values of observed quantities for those histories which terminate in Earth impact. Effects of secular perturbations caused by Jupiter are included in addition to effects caused by close approaches to planets. Extremely short (0-40 m.y.) exposure ages of chondrites can be produced only by initial orbits of the low geocentric velocity associated with lunar ejecta, or by initial orbits with aphelia in proximity to Jupiter. Initial orbits which meet all requirements are those of low inclination with aphelia near Jupiter's orbit and perihelia barely within that of the Earth. — *from* Author's abstract

06137 **Weyl, Richard.** Magnatische Förderphasen und Gesteinschemismus in Costa Rica (Mittelamerika) [with Spanish summ.]: Neues Jahrb. Geologie u. Paläontologie Monatsh. 1969, no. 7, p. 423-446, illus., tables, 1969.

Magmatism began in Costa Rica in the Late Cretaceous and is still going on. A number of individual phases are distinguished on the basis of previously published and new chemical analyses. The first magmatic products were mafic rocks of the oceanic Nicoya complex. Silica content tended to increase as magmatism progressed. All the magmatic phases produced material of Pacific affinities, with some internal differences. The products of Quaternary volcanism are chemically related to the rest of the Central American volcanic region. — DBV

06138 **Weyl, Richard.** Magnetitsande der Küste Nicoyas (Costa Rica, Mittelamerika) [with Spanish summ.]: Neues Jahrb. Geologie u. Paläontologie Monatsh. 1969, no. 8, p. 499-511, illus.. tables, 1969.

Beach sands and magnetite placers from the Pacific coast of the Nicoya Peninsula of Costa Rica are described. The minerals present are titanium-rich magnetite, plagioclase, augite, hypersthene, and hornblende. These are not derived from the basalts of the Nicoya Complex exposed on the coast, but probably are from the silica-rich tuffs of the Quaternary Bagaces Formation and volcanic products of the Cordillera de Guanacaste. The magnetite sands are partially consolidated into beachrock. — DBV

06244 **Whetten, John T.; Kelley, James C.; Hanson, Larry G.** Characteristics of Columbia River sediment and sediment transport: Jour. Sed. Petrology, v. 39, no. 3, p. 1149-1166, illus., tables, 1969.

Columbia River sediment is apparently derived from two principal sources: the upstream sediment from surficial deposits is derived ultimately from metamorphic, plutonic, and sedimentary rocks; the downstream sediment is derived largely from erosion of andesitic volcanic rocks and sediments. The upstream sediment is fine-grained and is transported by the Columbia in suspension. The volcanic sediment is coarser and generally forms the bedload. It is likely that these two sediment types remain more or less physically separated during transport and deposition. — *from* Authors' abstract

Whetten, John T. *See* Hawkins, James W., Jr. 06309

05997 **Whitaker, J. H. McD.; Gatrall, M.** Two "orientometers" for measuring lineations on hand specimens: Jour. Geology, v. 77, no. 6, p. 710-714, illus., 1969.

The term *orientometer* is introduced for an apparatus used to measure orientations of linear features in hand specimens. Two simple orientometers are described and their usefulness illustrated in studies of orientation of elongate fossils and of elliptical ooliths. — *from* Authors' abstract

06361 **White, Donald E.** Thermal and mineral waters of the United States — Brief review of possible origins, *in* Internat. Geol. Cong., 23d, Prague, 1968, Proc. Symposium 2, Mineral and thermal waters of the world — [Pt.] B, Oversea countries (Rept., V. 19): Prague, Academia, p. 269-286, illus., 1969.

A thermal spring is one which discharges at a temperature at least 5°C (10°F) above the mean annual temperature of the locality; subsurface waters are thermal if they are at least 5°C above surrounding "normal" environments. Mineral waters include those containing more than 1,000 ppm of dissolved substances, and a few more dilute waters of unusual composition. No satisfactory system of classification of all thermal and mineral waters has yet been devised; a modified genetic system is used for want of a better. The five classes — meteoric water, water perhaps in part connate, water perhaps in part metamorphic, juvenile water, and water perhaps in part volcanic or magmatic — are discussed, with examples. Isotope studies for magmatic water have revealed that thermal waters are overwhelmingly of metamorphic origin. The more highly mineralized waters offer the best chance of deciphering origin. — DBV

05808 **White, E. W.; Gibbs, G. V.** Structural and chemical effects on the Al Kβ X-ray emission band among aluminum containing silicates and aluminum oxides: Am. Mineralogist, v. 54, nos. 5-6, p. 931-936, illus., table, 1969.

The Al Kβ peak, as measured on the spectrometer of a microprobe, shifts as much as 8×10^{-3} A, as a function of Al coordination number and Al-O distance, but independent of O coordination number. — Authors' abstract

Whitehead, E. V. *See* Anderson, P. C. 06176

06100 **Widmer, Kemble.** Topographic and geologic mapping in New Jersey, *in* Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions — Geol. Soc. America, Ann. Mtg., Atlantic City, N.J., 1969: New Brunswick, N.J., Rutgers Univ. Press, p. 48-50, 1969.

Inaccuracies in Vischero's map of 1654 led to boundary disputes a century later. A British "geologic?" map of the Jerseys in 1777 showed every forge, furnace, and iron mine, but no roads in the Highlands. New Jersey was the first state to complete topographic coverage on a scale of 1:63,360, in atlas sheets. Following rapid urban growth in 1898, a larger scale series was prepared and revised, prior to the U.S. Geological Survey's 15 minute quadrangles and, since 1930, 7 1/2-minute series. Federal and State cooperation, 1902-10, produced five geologic folios. A series of soils bulletins, 1918-26, covered the entire state with soils maps remarkably parallel to underlying geology. In the 1950's, Rutgers University Engineering Research Bulletins provided maps and evaluation of soils distinct from agricultural soils. The geologic map of New Jersey will soon be revised for the third time. — GDC

Wightman, A. *See* Barden, L. 05983

Wigley, T. L. *See* Brown, M. C. 06038

Wilk, H. B. *See* Keil, Klaus. 05863

Willhite, M. R. *See* Baxter, Robert W. 06349

Williams, G. L. *See* Kidson, E. J. 06125

06230 **Williams, J. Stewart.** The Permian system in the Uinta Mountain area, *in* Geologic guidebook of the Uinta Mountains, Utah's maverick range — Intermtn. Assoc. Geologists (and Utah Geol. Soc.), 16th Ann. Field Conf. 1969: Salt Lake City, Utah, Utah Geol. Survey, p. 153-168, illus., 1969.

This paper reviews the information developed on the Permian System in the Uinta Mountains area in the one hundred years since these rocks were first recognized by Powell and King. It follows the history of Permian studies, and then attempts to describe the Park City Formation by copying the definitive descriptions of the type

sections of the members of the formation, discussing the upper and lower boundaries of the formation, describing its area of outcrop, and listing the locations of published measured sections. A review of the geologic history of the area in Permian time is based upon the recent paleotectonic studies of the Permian by McKee, Oriel and others. The paper concludes with a brief review of the biostratigraphy relying upon the work of J. Steele Williams and Ellis L. Yochelson. — Author's conclusion

Willis, D. E. *See* Bufe, C. G. 06034

Willis, J. P. *See* Ahrens, L. H. 05869

06120 **Willis, Joe C.** Definitive computations of sand discharge in rivers — Discussion [of paper 6350 by F. B. Toffaleti, 1969]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Hydraulics Div., no. HY6, p. 2185-2189, illus., 1969.

The physical assumptions upon which Toffaleti based his computation methods (ibid., v. 95, no. HY1, p. 225-248, 1969; *see* Abstracts of North American Geology, June 1969) are somewhat obscure. The surprising relation between the exponent of velocity distribution and temperature may be coincidental rather than general; the exponent is generally considered to vary somewhat with Reynold's number, but not necessarily with viscosity or temperature alone. Some changes in equations are proposed, and some terms redefined. Comparisons between computed and measured load in the sampled zone would be more meaningful. Deficiencies in some theoretical concepts are apparently compensated for by other empirical relations, such as the proposed nucleus load equation and "A" factors. — GDC

05802 **Wilson, Edward C.** No new *Ungdarella* (Rhodophycophyta) in New Mexico: Jour. Paleontology, v. 43, no. 5, p. 1245-1247, illus., 1969.

Ungdarella americana Toomey and Johnson, 1968, described as a red alga (Rhodophycophyta) from Middle Pennsylvanian rocks in New Mexico, is a junior synonym of the stromatoporoid (Coelenterata) *Komia eganensis* Wilson and Waines, 1963, previously reported only from Middle Pennsylvanian parts of the Ely Limestone and the Bird Spring Formation of eastern Nevada. Newly reported zooidal(?) tubes at the tips of branches form the axial canal in lower parts of the coenosteum. The reported existence of cells and "ball-like tips" of branches in this organism are morphological misinterpretations. — Author's abstract

Wilson, T. E. *See* Bruner, E. C., Jr. 06274

05813 **Wise, W. S.; Nokleberg, W. J.; Kokinos, M.** Clinoptilolite and ferrierite from Agoura, California: Am. Mineralogist, v. 54, nos. 5-6, p. 887-895, illus., tables, 1969.

Coexisting clinoptilolite and ferrierite occur in cavities in andesitic breccia near Agoura, Los Angeles County, Calif. The average cell contents are given for both. The clinoptilolite is similar in composition to reported analyses, whereas the ferrierite is far richer in Si and alkalies compared to published analyses. The clinoptilolite crystals display a form, $(20\bar{1})$, not reported for heulandite. The optic orientation with OP parallel to (010) and $Z\,a = 30°$ to 45° is distinctly different from that of heulandite. Other properties are $2V_z = 32°$-48° and $\beta = 1.479$. Small fibers (0.01 mm) of ferrierite prevent detailed optical study. Ferrierite cell dimensions and peak intensities may reflect compositional variation. The earlier precipitation of calcite probably allowed these Si and alkali-rich zeolites to crystallize from water percolating through the breccia. — *from* Authors' abstract

05677 **Withrow, Jon R.** Geology of Cromwell Sandstone Member, Franks Graben area, Coal and Pontotoc Counties, Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 11, p. 2299-2313, illus., tables, 1969.

The Cromwell Sandstone Member of the Union Valley Formation (Pennsylvanian) in six townships in Coal and Pontotoc Counties, Okla., consists of three distinct lithofacies types. The types are identified as parallel depositional bands of shaly, transitional, and sandy quality. The Member thickens and the sandstone/shale ratios

increase northward. Proved petroleum reserves in the Cromwell are related to the facies. The shale facies of the Member provided the barrier for a stratigraphic trap which was divided into separate fault blocks during the Wichita and Arbuckle orogenies (Pennsylvanian). — *from* Author's abstract

06328 **Wlotzka, F.** On the formation of chondrules and metal particles by "shock melting", Paper 16 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, Springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 174-184, illus.; discussion, p. 219-220, 1969.

Observation in Ramsdorf meteorite of shock-formed silicate structure similar to that in porphyritic chondrules strengthens the feasibility of Urey's hypothesis and of Fredriksson and Ringwood's mechanism for chondrule formation; the sudden escape of volatiles as a means to disrupt the molten rock into droplets, as conceived by Fredriksson and Ringwood, does not seem necessary as acceleration by collision energy may do the same thing. One may even speculate that nickel-iron particles of chondrites were also formed by shock melting of pre-existing metal grains. Rounded particles of nickel iron which apparently have been molten were found in Ramsdorf. It is shown that it may be possible to produce the taenite particles in chondrites and their M-shaped Ni-concentration profiles during rapid cooling which also formed partly glassy silicate chondrules. — *from* Author's abstract

Wölfle, R. *See* Herpers, U. 06316

Wong, Chung-ming. *See* Collins, A. Gene. 06080

Wood, Albert E. *See* Loring, Stephen H. 05797

06159 **Wood, Elizabeth A.** Science for the airplane passenger: New York, Ballantine Books, 223 p., illus., 1969.

This popular account of science from the air contains the following chapters: taking off; standing water; coastlines; running water; light; clouds; wind, rain and snow; quantitative measurements; frames of reference; rock structures; vegetation; man-made structures; flying at night; and landing. A list of books for suggested reading includes titles on: the airplane and its operation, archeology, clouds and meteorology, geology and geography, light, scale of objects from various elevations, and storms. — MCM

Wood, Fergus J. *See* Leipold, Louis E. 06263

05800 **Wright, A. J.** Notes on tetracoral morphology: Jour. Paleontology, v. 43, no. 5, p. 1232-1236, illus., 1969.

Initially only two protosepta — the cardinal and the counter septa — were inserted in the cardinal and counter fossulae respectively or in a single fossula in the plane of symmetry. All subsequent septa were metasepta and were inserted in the cardinal-lateral, counter-lateral, and rarely in the infra-lateral fossulae. Septal notation should show nature, location, and order of appearance of the septa. Abbreviated septal formulae should be constructed to facilitate comparison of species. Use of the existing ontogenetic stage terminology is not recommended for tetracorals. — *from* Author's abstract

Wright, Ramil C. *See* Bandy, Orville L. 06061

06370 **Yang, Tsung.** Dispersion of silt particles in open channel flow — Discussion [of paper 6579 by W. W. Sayre, 1969]: Am. Soc. Civil Engineers Proc., v. 95, Jour. Hydraulics Div., no. HY6, p. 2206, 1969.

The Aris moment transformation introduced by Sayre (ibid., v. 95, no. HY3, p. 1009-1038, 1969; *see* Abstracts of North American Geology, Feb. 1970) simplifies the dispersion equation by reducing the number of variables in it, but the solution cannot provide the longitudinal distribution of the dispersant itself. However, moments thus

obtained will provide sufficient information of the dispersion process. With different initial and boundary conditions, the Aris moment equations can be used to simulate different dispersion processes. Applied in an extended study to simulate sand dispersion along an alluvial bed, excellent comparison was obtained between the Aris equations and a general one-dimensional stochastic model (1968 dissertation). A separate paper on this application will be submitted by Yang and Sayre. — GDC

Yaniv, A. *See* Bernas, R. 05866

Yenne, K. A. *See* Yerkes, R. F. 06364

Yerkes, R. F. *See* Hamilton, R. M. 06189

06364 **Yerkes, R. F.; Wagner, H. C.; Yenne, K. A.** Petroleum development in the Santa Barbara Channel region, Chap. B *in* Geology, petroleum development, and seismicity of the Santa Barbara Channel region, California: U.S. Geol. Survey Prof. Paper 679, p. 13-27, table, 1969.

Oil, tar, and gas have been features of the natural environment of the Santa Barbara Channel region for thousands of years; petroleum has been the chief mineral resource for decades. In 1968, the oil fields produced 22.9 million bbl oil, about 6 percent of California's production. The first commercial oil well in California, completed in 1866 just east of the channel region, was located on the basis of oil seeps. Since that time prospecting on land and offshore by geophysical methods has continued. Oil fields along the Rincon anticlinal trend, including the offshore Carpinteria field, have completely dominated production statistics of the region; their large production is attributable to thick, oil-saturated sections and relatively high porosities and permeabilities. — *from* Authors' summary

05785 **Yochelson, Ellis L.; Marek, Ladislav; Flower, R. H.** Late Cambrian hyolithoid *Kygmaeoceras* redescribed: Jour. Paleontology, v. 43, no. 5, p. 1274-1276, illus., 1969.

The Late Cambrian *Kygmaeoceras perplexum* is redescribed from topotypes [from the San Saba Limestone Member of the Wilberns Formation, Gillespie County, Tex.] and assigned to the Hyolitha. Although the genus is an orthothecoid hyolithan, several features are atypical of the order, including the relatively narrow cross section and the extreme slenderness of the shell. Periodic slight riblike swelling of the *Kygmaeoceras* aperture is a feature not reported in other members of the class. — Authors' abstract

06298 **Yong, R. N.; Chang, R. K.; Warkentin, B. P.** Temperature effect on water retention and swelling pressure of clay soils, *in* Effects of temperature and heat on engineering behavior of soils — Internat. Conf., Washington, D.C., 1969, Proc.: Highway Research Board Spec. Rept. 103 (NRC-NAS-NAE Pub. 1641), p. 132-137, illus., 1969.

As predicted from simplified theory, increased temperatures cause increased swelling pressures and decreased capillary water retention values in experiments where only one of the components is active. However, where the two components exist together, the two opposing trends cause different effects under temperature changes. In clay-glass bead mixtures, this may be traced to aggregate size. Where aggregate sizes are large, the swelling pressure mechanism dominates. Thus, where clay content is small, swelling of oriented clay between aggregates occurs as a dominant mechanism in water retention. On the other hand, capillary effects are dominant in the high-clay system where clay particles are irregularly aligned. — *from* Authors' conclusions

05878 **Young, J. A. T.** Variations in till macrofabric over very short distances: Geol. Soc. America Bull., v. 80, no. 11, p. 2343-2352, illus., table, 1969.

The preferred orientation of the long axes of the stones in apparently homogeneous till varies considerably in depths of not more than 60 cm; there is no consistency in the rate and degree of variation with depth. Lateral variations in long-axis orientation

over similar distances are small in comparison. Measurement of 50 stones produced a result very comparable to that obtained from measurement of 100 stones. No overall pattern exists in the plunge of the long axis of the stones, even where similar orientation is found, and thus plunge is of no value in determining the direction of ice movement. — Author's abstract

05952 **Zachry, Doy Lawrence, Jr.** Carboniferous stratigraphy of the Chappel area, San Saba County, Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 4, p. 1761B-1762B, 1969.

Zähringer, J. *See* Kaiser, W. 05848

Zähringer, J. *See* Muller, H. W. 06336

05859 **Zeller, E. J.; Dreschhoff, G.** Formation of organic compounds in solid bodies by solar and cosmic proton bombardment, Paper 44 *in* Meteorite research (P. M. Millman, editor) — Symposium, Vienna, 1968, Proc.: New York, springer-Verlag (Astrophysics and Space Sci. Libr., V. 12), p. 524-533, illus.; discussion, p. 538, 1969.

Little consideration has been given to processes other than biologic which might produce organic compounds in meteorites after termination of gas-phase interactions in the solar nebula. Measurable quantities of hydroxyl ions and hydrocarbons can be produced in solids by proton irradiation. Experimental work has been limited to irradiation of pure crystalline substances, but in meteorites mixtures of carbon-oxygen- and nitrogen-containing substances might react more readily under proton bombardment to produce complex organic molecules. Meteorites and other small bodies orbiting the Sun are exposed to high-energy particles in quantities large enough to produce measurable effects within a few million years. If radiation flux in the past were larger, or if carbonaceous chondrites were at or near the parent body surface, such solid-state reaction may have been important in organic compound production. — *from* Authors' abstract

06368 **Zengeni, Teddy G.** PKKP and the Earth's core [abs.]: Earthquake Notes, v. 40, no. 2, p. 11, 1969.

06192 **Zenger, Donald H.; Pearson, Eugene F.** Stratigraphy and petrology of the Lost Burro Formation, Panamint Range, California, *in* Short contributions to California geology: California Div. Mines and Geology Spec. Rept. 100, p. 45-65, illus., table, 1969.

A regional change from a lower Paleozoic dolomitic sequence to upper Paleozoic limestone occurs within the 2,000 feet thick Devonian Lost Burro Formation. In the type locality, the Panamint Range, the formation consists mainly of gray, thick-bedded, generally poorly fossiliferous carbonates, and comprises five units; contacts with underlying Hidden Valley Dolomite and overlying Tin Mtn. Limestone are sharp but are considered essentially conformable. Terrigenous material is chiefly quartz, microcline, and 'muscovite'; median insoluble content is about two percent; there is no correlation between insoluble residue and dolomite content. Petrographically the unit is divided into nine microfacies. The environment of deposition was shelf-like, the limestone probably representing lower energy, farther offshore deposits than the dolomite. — *from* Authors' abstract

06304 **Zimmerman, Richard A.** Sediment-ore-structure relations in barite and associated ores and sediments in the upper Mississippi Valley zinc-lead district near Shullsburg, Wisconsin [with German abs.]: Mineralium Deposita, v. 4, no. 3, p. 248-259, illus., 1969.

Study of sediment-ore-structure relations in the Blackstone, Temperly, and Teasdale mines indicates that ores lie in layers and in breccia near and in sag or basin structures at the base of the Quimbys Mill Member of Platteville Formation. Structure and bedding relations of the contorted calcite- and sphalerite-bearing limestone layers show that the ores were present in the sediment during deformation. Geopetal and compaction features such as sphalerite nodules in carbonaceous limestone and the

bulged ore layers further indicate a sedimentary and diagenetic origin for the ores. — *from* Author's abstract

06107 **Zonge, Kenneth L.** Model three — Lightweight low cost self potential unit: Alaska Univ. Mineral Industry Research Lab. Rept. 17-B, p. 1-5, illus., 1969.

This brief report, a supplement to ibid., Rept. 17, 1968, describes an improved version of the low cost self potential unit. Improvements incorporated contribute to amplifier stability (less zero drift), longer battery life, and ease of operation. – MCM

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